Electrical World

NOVEMBER 24, 1945

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High Plant Economy Achieved at Stamford

•

Joint Line Evolved for Power and Telephone Service

•

Determining Ratio of Delta-Connected Bushing Current Transformers

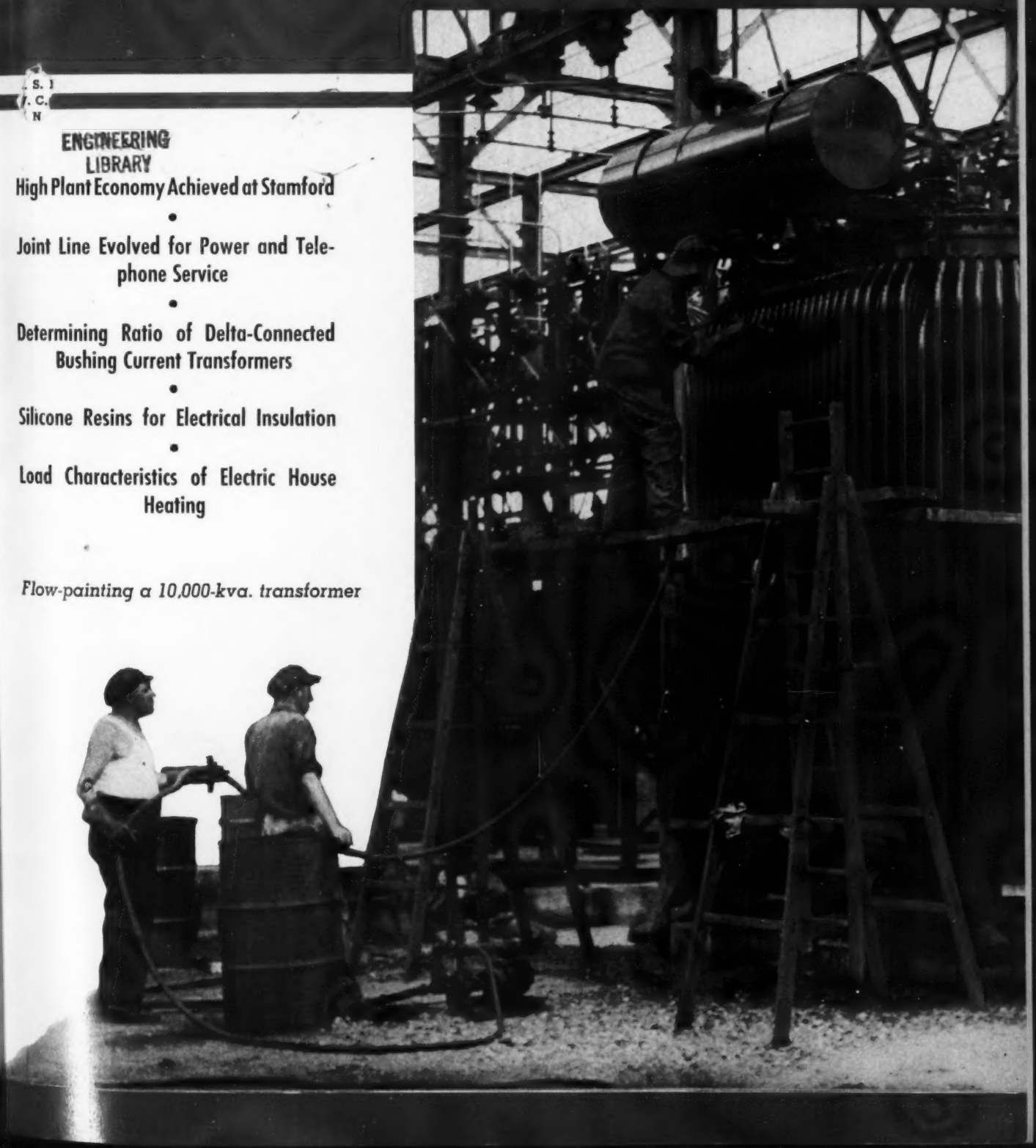
•

Silicone Resins for Electrical Insulation

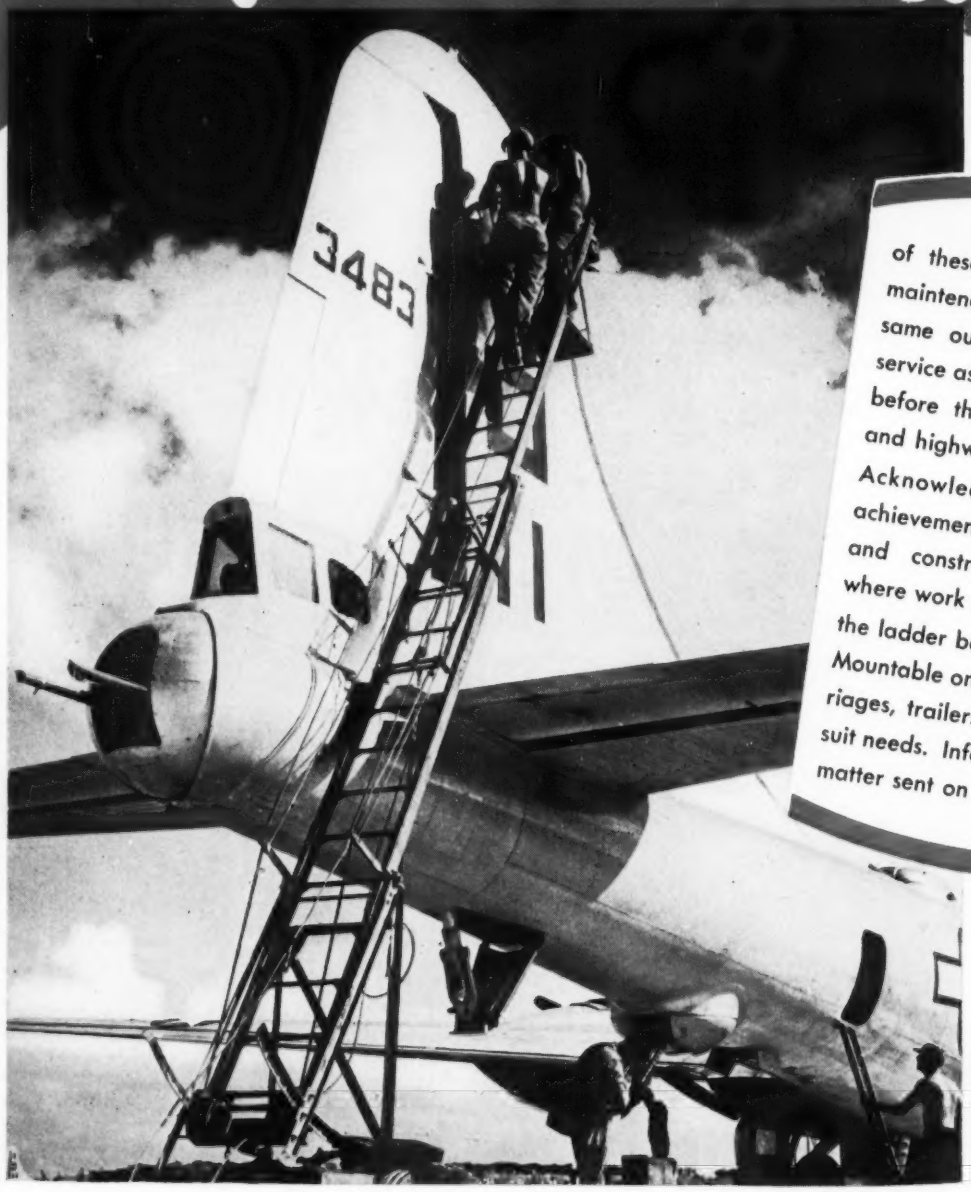
•

Load Characteristics of Electric House Heating

Flow-painting a 10,000-kva. transformer



One of the "400" — as in war — so in peace



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ELECTRICAL WORLD

Published weekly. Price 25 cents a copy. Publication office 99-129 N. Broadway, Albany 1, N. Y. Allow at least ten days for change of address. Address communications about subscriptions to Director of Circulation, Electrical World, 330 West 42nd Street, New York 18, N. Y.

RETURN POSTAGE GUARANTEED

Subscription rates: In the United States, Mexico, Central and South American countries, $5 a year, $8 for two years, $10 for three years. Canada $6 for one year, $10 for two years, $12 for three years (Canadian money at par). Great Britain and British possessions, 60 shillings for one year, 120 shillings for three years. All other countries $9 for one year, $18 for three years. Please indicate position and company connection on all subscription orders. Entered as second class matter November 16, 1936, at Post Office at Albany, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

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Branch Offices: 520 North Michigan Avenue, Chicago 11, Ill.; 68 Post Street, San Francisco 4; Aldwych House, Aldwych, London, W.C. 2; Atlanta, Ga.; Boston, Cleveland, Detroit, Los Angeles, Philadelphia, Pittsburgh, St. Louis, Washington.

McGRAW-HILL PUBLISHING CO., INC.
JAMES H. McGRAW
Founder and Honorary Chairman

Publication Office
99-129 North Broadway, Albany 1, N. Y.
Editorial and Executive Offices
330 West 42nd St., New York 18, N. Y.

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Cable Address McGRAW-HILL, New York

November 24, 1945 — Vol. 124, No. 21

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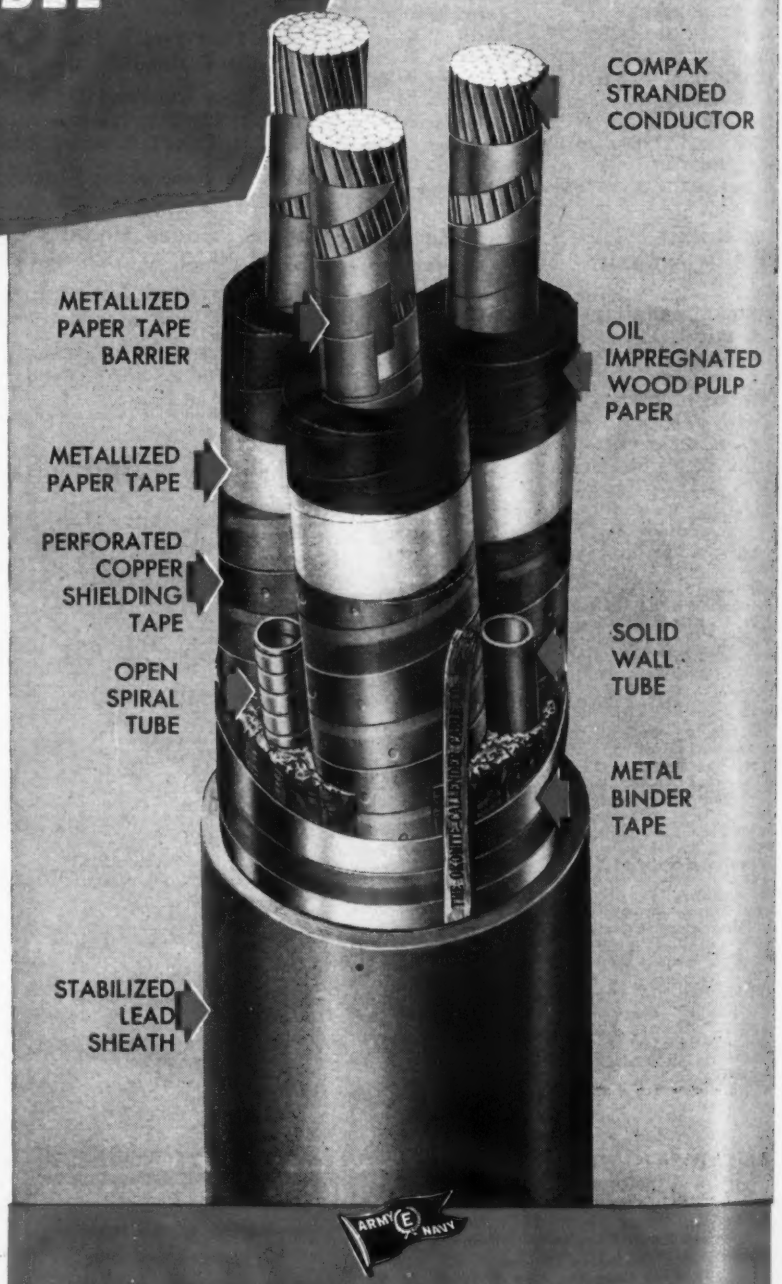

Applications

Okonite-Callender low gas pressure cable can be used wherever solid type cable would normally be installed for operation at 10-40 kv. It can be used to advantage where steep grades give rise to pressure problems with solid or oil-filled cables.

Advantages

- This design prevents development of excessive internal pressures such as occur in solid type cables under heavy load conditions.
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The Okonite-Callender Cable Co., Inc., Executive Offices, Passaic, N. J. . . . Write for Bulletin OK-1023

Electrical World

NOVEMBER 24, 1945

Two Thousand by 1950

A NEW MILESTONE of 100 kw.-hr. per month average residential use of electricity was announced earlier this month by the Edison Electric Institute. Ten years ago the average was approximately half that amount. Compared with the figures at the end of the last war, the achievement is impressive. Compared, however, with what has been accomplished in some areas of this country and Canada, the achievement constitutes a challenge to a large segment of the utility industry of this country.

If we were to break down the national figures into regional usages, we would find that the greatly higher than average consumptions per customer prevail fairly generally in regions where the average family income is not high. In the more prosperous industrial areas of the East and the Middle West, for instance, we do not find the same high usages that are fairly general in the Southeast and Northwest. Nor do we find in some of the older areas, that take great pride in their advanced standards of living and culture, that the average family has taken advantage of the most important tool of modern living to anything like the same degree as the average family below the Mason and Dixon line. Surely there can be no high standard of living without a high use of modern methods of living.

In no section of this country do we even come close to the average residential usages in the several areas of Canada. Can we still boast of having the highest standard of living when we see others across the border faring better in the most modern means of living?

Regardless of explanations these disparities, or at least the degree thereof, need not exist provided (1) we sell complete electric usage in the home in communities where gas and electricity are under the same management and (2) we have an objective based not on past performance but upon the job to be done.

Some people have urged that common ownership of gas and electric properties be not permitted, but we can see no justification for such action provided only that each service is made to stand on its own feet. To retard electric growth merely to protect an investment in gas plant may in the long run be found to be a "penny wise and pound foolish" policy. Gas and electric services are by nature monopolistic only because it is uneconomic to have competing systems but that does not mean that the public is going to be willing to accept any restrictive practices. Electricity must be promoted just as vigorously as gas even for competitive uses.

With so great a job to be done the rate of growth of the past can be no guide to the future. Goals must be based on objectives sought and then the way to realization found. At the beginning of the war we suggested double the average in the first five years after the war. That would mean 2,000 kw.-hr. average by 1950. In the light of considerably higher averages already in certain sections of the country and 5,000 kw.-hr. in several places in Canada, this 2,000 kw.-hr. should not seem to be too difficult of attainment by progressive management.

Let's not pause very long for mutual admiration over reaching the 100 kw.-hr. a month residential average, for others have passed that point a long time ago. Instead let up put on even greater speed to reach the goal of 2,000 by 1950.

High Plant Economy at Stamford

Three years' service following addition of 25,000-kw., 850-psi. boiler and turbine unit for base load—New unit on line over 90 percent of the time—Heat balance designed for efficient production accompanied by relatively simple equipment layout

OPERATING RESULTS since the installation of new generating equipment at the Stamford steam plant of the Connecticut Power Co. illustrate the advantages of a well selected heat balance, pressure and temperature ratings in combination with a base load unit of sufficient capacity to achieve highly satisfactory economy when run for 90 percent or more of the time each year. The Stamford extension went into service in October, 1941. The underlying principles of design were to achieve safety, service reliability, operating simplicity, and reduced cost of production. The objective was to balance installation cost, maintenance expense, and thermal efficiency to give the lowest overall cost of electrical energy consistent with the foregoing features. Fuel rate on the new unit was expected to be 11,230 B.t.u. per kw.-hr. generated. No complete test with all necessary corrections was made, but operating results indicate that the estimate is being met closely.

The new unit was on the line 91 percent of the time in 1942, 90 percent in 1943 and 92 percent in 1944.

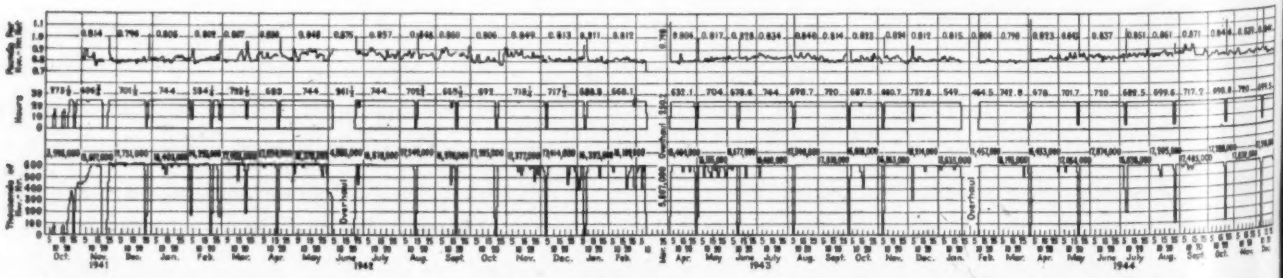
Station Equipment

Six turbo-generators and seven boilers comprise the main steam equipment at Stamford. There are four 600-hp., 200-psi. B. & W. boilers used for standby and steam supply to an affiliated gas plant; two 400-psi. B. & W., each rated at 180,000 lb. per hour, and a 250,000-lb. per hour, 915-deg. B. & W. boiler designed for vertical firing with either pulverized coal or oil.

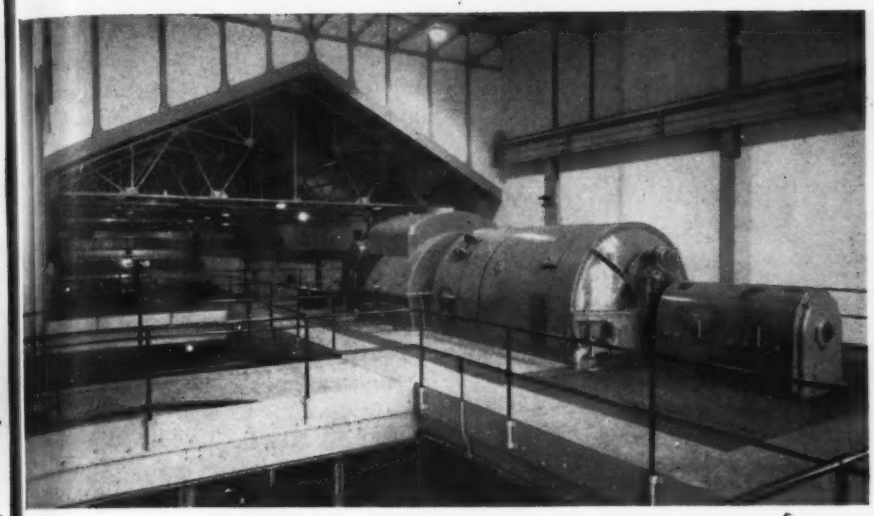
The latter steam generator, which forms a unit with the 25,000-kw. turbine, has a completely water-cooled furnace with a volume of 20,250 cu.ft., all evaporation taking place here. Within the boiler setting are a 7,500-sq.ft. economizer and an 8,864-sq.ft. superheater, separated from the furnace by a baffle wall. There is no boiler tube surface. The gases pass over the superheater and economizer consecutively. Control of steam temperature is obtained with an external interstage attemporator containing a steam by-pass damper to regulate the former. This is arranged for automatic control. The water supply to and from the attemporator is a part of the boiler circulation system. Two regenerative air preheaters located over the economizer section reduce the flue gas temperature at full boiler output to 323 deg. F. with oil firing, or 315 deg. F. with coal firing. Steam is delivered at the superheater outlet at 875 psi. and 915 deg. F. This suffices to supply full turbine load of 25,000 kw. at 80 percent power-factor, with a suitable margin of reserve capacity with only one circulating water pump running. This boiler can also furnish steam through a reducing valve to the lower pressure piping headers if desirable.

Turbo-Alternators

There are two 2,500-kw., 2,300-volt, turbo-generating units, a 6,240-kw. unit and a 12,500-kw. unit delivering energy at 4 kv., and a 15,000-kw. machine, which with the 25,000-kw. unit, delivers energy at 13.8 kv. The three larger machines and the 875 and 400-psi. boilers normally carry the load. On a typical day shown in the accompanying 24-hr. load curve (Feb. 1, 1945), the 875-psi. boiler ran 24 hr., one 400-psi. boiler ran 18 hr. 5 min., and the other 400-psi. boiler 16 hr. 30 min. The 25,000-kw. generating unit ran 24 hr.; the 15,000-kw. unit ran 18 hr. 5 min., and the 12,500-kw. unit 16 hr. 30 min. From 7 a.m. to 10 p.m. on this day (a Thursday) the total load on the plant was held flat at 48,000 kw., the fluctuations of the Stamford load being offset by corresponding deliveries to a 66-kv. two-circuit



THREE YEARS OF OPERATION OF 25,500-KW. UNIT showing day-by-day service on line, hours of service per month, coal consumption per kilowatt-hour net, and monthly energy production. Normally inspections occurred in alternate months, with annual shutdown for overhaul. This does not take into consideration the quality or the B.t.u. content of the coal burned.



25,000-KW. GENERATING UNIT in turbine room

transmission line tying the system into that of another utility. Gross generation was 985,000 kw.-hr., of which the 25,000-kw. unit delivered 600,000 kw.-hr.; the average load on the station (gross) was 41,000 kw., and the 24-hr. load-factor 85.4 percent.

Tandem Compound

The largest generator in the plant is a General Electric 850-psi. hydrogen-cooled machine running 3,600 rpm. and capable of continuous operation at 31,250 kw. at 100 percent power factor, with salt harbor water delivered to the coolers at 85 deg. F. The turbine is of the tandem compound double-flow type with 18 stages single flow and three stages double flow, extraction for feed water heating being at the 10th, 14th and 18th stages. It will develop 31,250 kva. with full extraction. The turbine is designed to permit operation at 49 percent rating during emergencies with 725 deg. F. steam from the 400-psi. boilers. A 2-pass 25,000-sq. ft. Westinghouse surface condenser below the turbine exhaust is supplied with salt water from Stamford Harbor by two propellor type circulating water pumps. Each pump has a capacity of 21,000 gpm., but when both operate in parallel the combined circulating water installation capacity is 30,000 gpm. All auxiliaries are motor-driven except pumps for emergency boiler feed, emergency fuel oil, turbine oil, steam jet vacuum and emergency air compressor.

Heat Balance, 25,000-Kw. Unit

As shown in the basic flow diagram, condensate is pumped from the hot well through the inter- and after-condensers of the condenser air removal system to an open heater which is supplied from the 18th extraction point of the turbine. A booster pump then delivers it through the 14th stage heater and evaporator condenser to a second open heater supplied from the 10th stage. Boiler feed pump suction from the storage tank on this heater delivers the water through a desuperheating heater to the economizer. Steam from the 10th extraction stage, before passing to the 10th stage open heater, is desuperheated in this closed heater, the feed water being raised about 7 deg. F. above the saturation temperature of the extracted steam. This arrangement avoids degradation of energy, since the closed heater permits raising the feed water temperature above the saturation temperature of the 10th stage extraction, which would be impossible were this 10th stage extraction steam deposited directly in the 10th stage open heater.

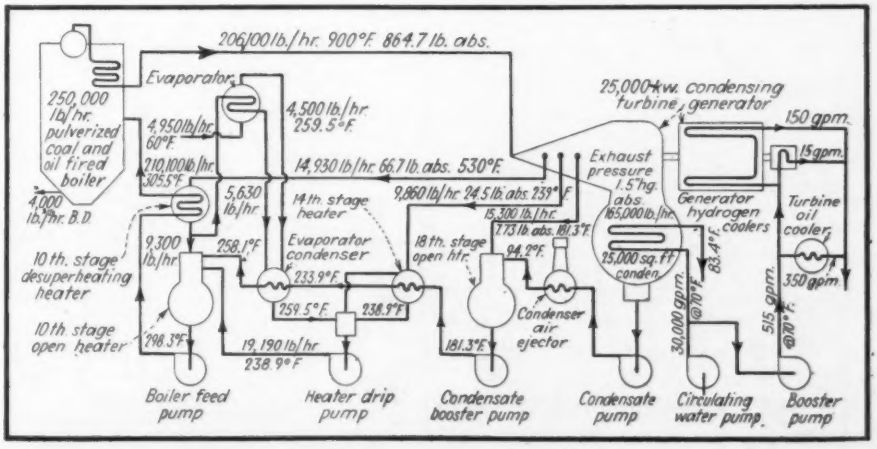
Open heaters, by heating the feed water to the full saturation temperature of the steam supplying them, extract more steam than is possible with a closed heater, where some terminal difference is unavoidable. Open heaters are specially desirable for the lower stages of extraction where extraction should be as great as possible. In this installation the use of the open type of heater was clearly indicated, as maximum low point extraction avoids as far as possible loss of heat to the condenser cooling water system. The use of open heaters applies to all extraction heaters in the system.

The use of open heaters applies quired with every open heater in the condensate line, the cost would have been higher had this type been employed for the 14th stage instead of the closed type heater used here. The boiler feed pumps, which take their suctions from the high point extraction heater, make an open type heater most economical for service at this point.

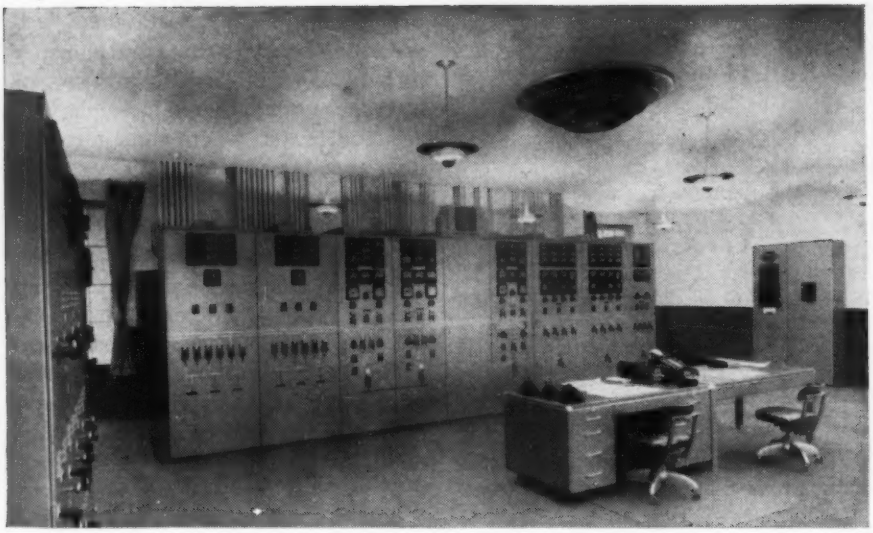
3-Point Extraction

In theory, the greater the number of steps employed in extraction feed water heating, the greater the cycle efficiency; but the added cost and complexity resulting from the use of more extraction points and their associated heaters limits the number of justifiable points. For the Stamford installation 3-point extraction represented the optimum balance between the various principles of design outlined above.

Instead of the usual cascading of drips to the lowest point heater, a drip pump handles these from the 14th stage heater. To avoid the cost and



BASIC FLOW DIAGRAM for 25,000-kw. boiler and turbine unit, with major auxiliaries, for a normal load of 25,571 kw.

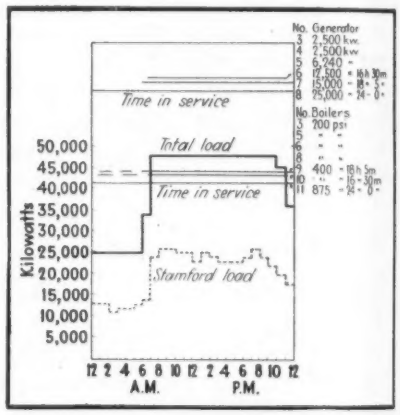


ELECTRICAL CONTROL ROOM after improvements were completed

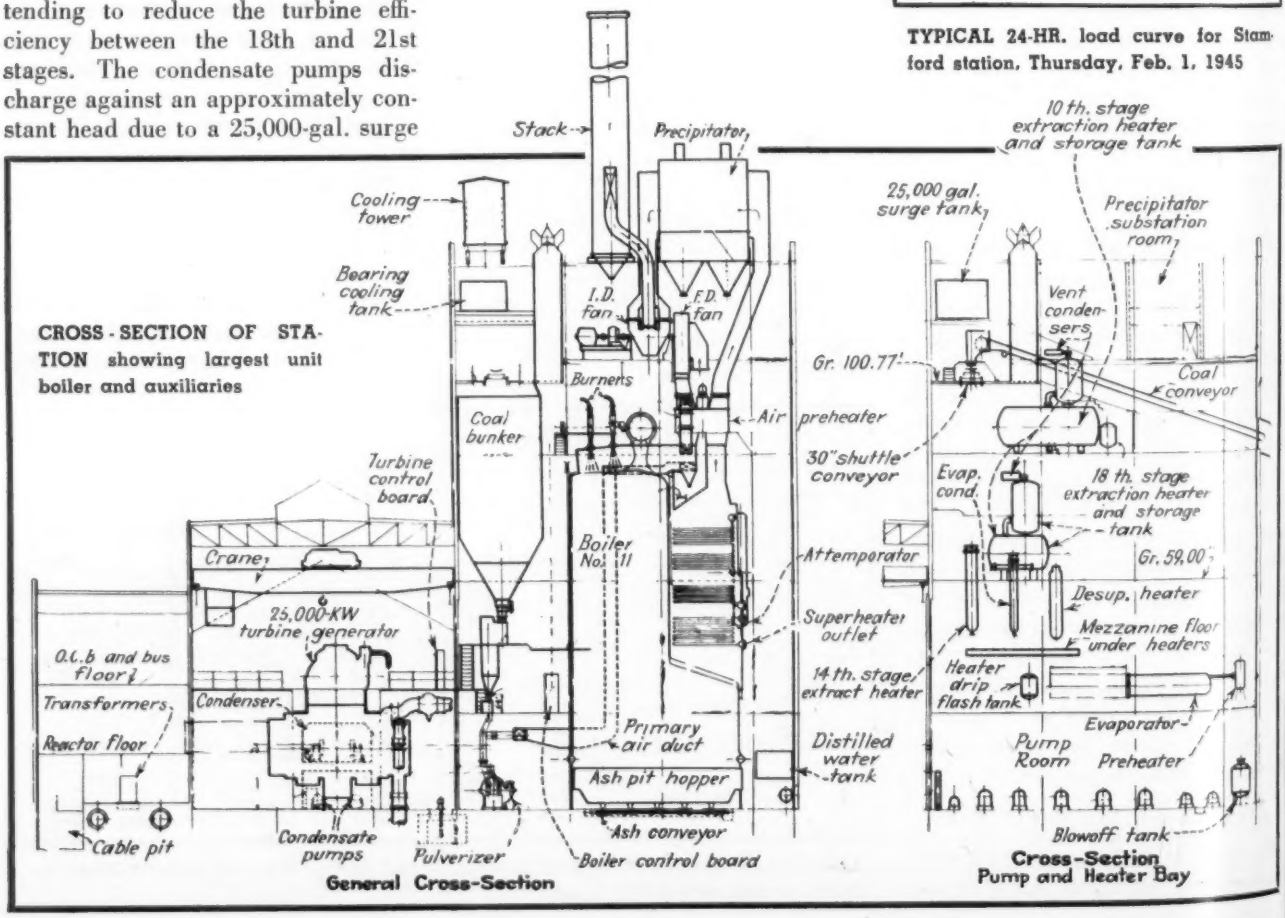
complexity of a duplicate pump, provision has been made for trapping drips to the main condenser when the pump is out of service.

A separate salt water cooling system for hydrogen and turbine oil was provided. The amount of condensate is insufficient for this purpose, and even if it were used to achieve an apparent saving, the result would have been to increase the steam flow to the condenser, thus increasing the heat rejected to the circulating water and tending to reduce the turbine efficiency between the 18th and 21st stages. The condensate pumps discharge against an approximately constant head due to a 25,000-gal. surge tank floating on the line between the pumps and the 18th stage heater. Condensate flow to the heater is controlled by a float valve. Each of the two pumps can deliver 600 gpm. and is driven by a 40-hp. constant speed motor.

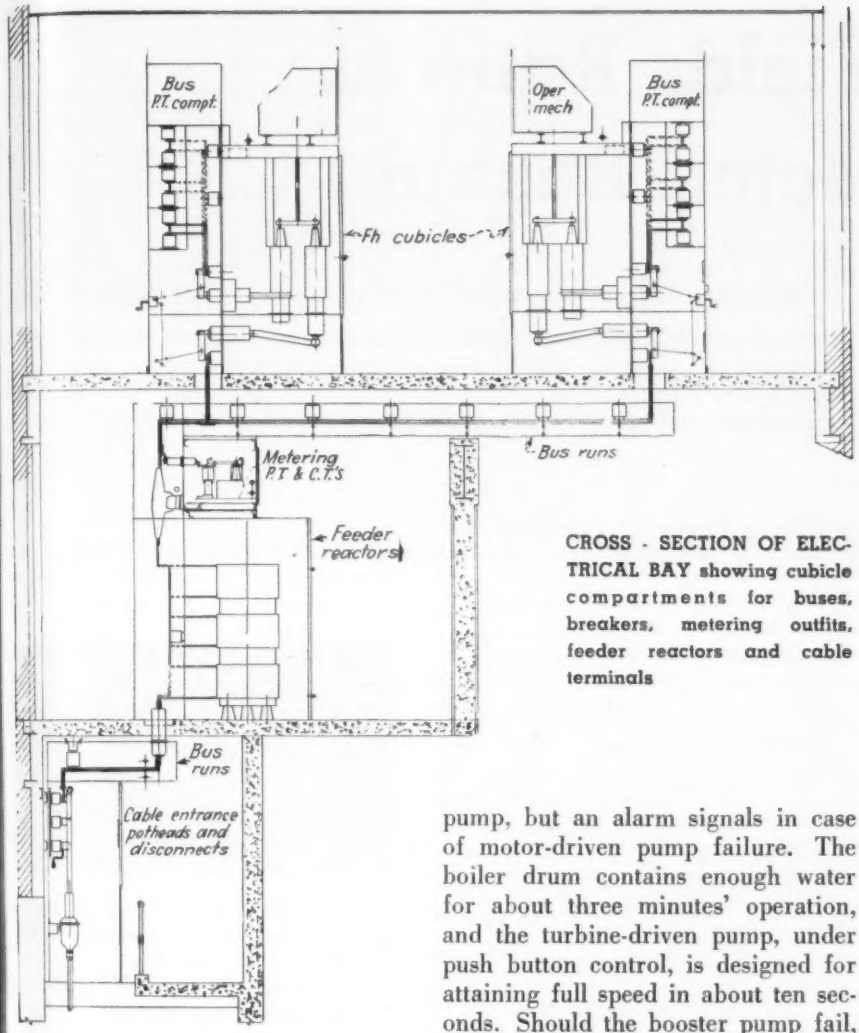
Three Ingersoll-Rand boiler feed pumps, each running at 3,600 rpm. and having a capacity of 330,000 lb. per hr. at a total dynamic head of 2,650 ft., are installed. One is turbine driven and two have constant speed motors. Although some power might have been saved by using variable speed motors, the added cost and complexity could not be justified in view of the small percentage of time the pumps would run below 3,600 rpm. Each pump has sufficient capacity to supply the boiler with feed water at the maximum output. Similar points led to the use of constant speed motors on the two 1,800-rpm. condensate booster pumps, each having a capacity of 620 gpm. against a head of 303 ft. Because the evaporator and condenser are inserted between the first and second extraction point heaters, the heat balance is little affected by the quantity of make-up



TYPICAL 24-HR. load curve for Stamford station, Thursday, Feb. 1, 1945



CROSS-SECTION OF STATION showing largest unit boiler and auxiliaries



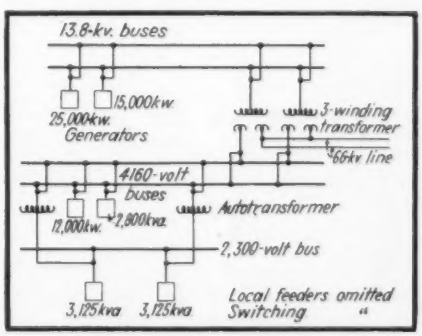
CROSS - SECTION OF ELECTRICAL BAY showing cubicle compartments for buses, breakers, metering outfits, feeder reactors and cable terminals

vaporized. To permit maximum evaporator capacity for a given size shell, steam is supplied to the evaporator from the first extraction point after it has passed through the desuperheating heater. The evaporator has a capacity of 8,300 lb. per hr. under normal operation at maximum turbine output, but this can be stepped up to 10,000 lb. per hr. by cutting off the steam supply to the second extraction heater. Sufficient water storage is provided in the feed water supply system to maintain full load on the unit for 64 min. City water may be introduced into the system at three points. Circulating water supply temperatures range from 32 to 80 deg. F. during the year.

Feed Water Controls

Both automatic and manual controls are provided for the feed water system. Operators can start and stop equipment in any desired sequence. There is no automatic starting of the emergency turbine-driven boiler feed pump, but an alarm signals in case of motor-driven pump failure. The boiler drum contains enough water for about three minutes' operation, and the turbine-driven pump, under push button control, is designed for attaining full speed in about ten seconds. Should the booster pump fail, the 10th stage heater storage tank capacity gives ample time to start the spare pump.

Other improvements included in the steam disposal plant have been the installation of a Cottrell precipitator for fly ash disposal; the Hall system of feed water treatment; a Robins Conveyor belt system for coal handling; and the provision of Riley coal pulverizers for the latest boiler. Coincidently with the steam installation outlined above, major improvements were made in the electrical layout of the station. These involved new construction of switch and bus compartments with "FH" General Electric, prefabricated-steel cubicles and gear for oil circuit breakers, separate reactor, circuit breaker and bus, cable terminal and control rooms. In ELECTRICAL WORLD, August 23, 1941, pages 82 and 84, illustrated reference was made to a saving of over 44 tons in construction by the use of steel cubicles compared with concrete breaker cells and bus compartments.



SINGLE-LINE DIAGRAM of generator and bus layout omitting circuit breaker and auxiliary electrical connections

Rectifiers for Compressor Engine Ignition

Rectifier units are used for preliminary ignition current on each one of the 58 compressor-engines employed on the new 24-in., high pressure gas line from Corpus Christi, Texas, to Cornwell, W. Va. Engine ignition is direct current, impulse type, with individual induction coils for each spark plug. The primary power supply is 440 volts, 3 phase, 60 cycle; and the output is 10-14 volts, 2 to 4 amp. d.c., sufficient to supply ignition demands of all engines. There are no batteries in the ignition circuit.

Use of the Westinghouse Rectox unit provides a fool-proof interlock between the main line compressor engines, the water circulating pumps and the station service generators. If the station service generators fail for any reason, the resulting loss of electric power stops the circulating pumps which cool the compressor engines. Since the compressor engine ignition system also shuts down on electric power failure, the compressors are stopped at the same time as the circulating water pumps go out, thus making it impossible for the main engines to overheat by running after failure of the cooling water system.

Another advantage is that each machine is independent of all others. The entire station cannot be shut down through the failure of an element of the ignition supply, which is always possible where a central battery and charger system is used.

Finally, the system is reported to have lower installation and maintenance costs than one with individual magneto or central battery and charger.

Field Test Yields Ratio of Delta-Connected Bushing C.Ts.

Presents method of connecting burden of delta-connected bushing current transformers, used with differential relaying, so that ratio can be determined simply—Value of burden is modified for test to give equivalent volt-amperes per transformer existing in service

CARL E. ASBURY, Relay Engineer, Illinois Power Co., Decatur, Ill.

ALTHOUGH conventional methods of testing bushing current transformers cannot be applied directly to delta-connected current transformers, it is possible to reconnect the secondary burden of such delta-connected current transformers so that the ratio can be determined by simple test methods with sufficient accuracy for relaying purposes and for calibrating indicating instruments of the switchboard type. This method, which has been used successfully by the author, will be outlined herein.

Where bushing current transformers are used for differential relaying on transformer banks, it is often necessary to connect one set of the bushing current transformers in delta to provide current of the proper phase relation to the relays. In such case, when normal load current or three-phase fault current flows through the transformer bank, current through the burden, from the delta-connected current transformers, is 1.73 times the current in the secondary of each bushing current transformer. Since three phases are involved and three transformers used, one-third of the total burden is on each transformer. For a given primary test current, in one bushing current transformer, it is necessary to simulate 1.73 times current flowing through the burden of one phase of the secondary circuit in order to obtain the equivalent volt-ampere burden imposed on each of the three delta-connected transformers in service.

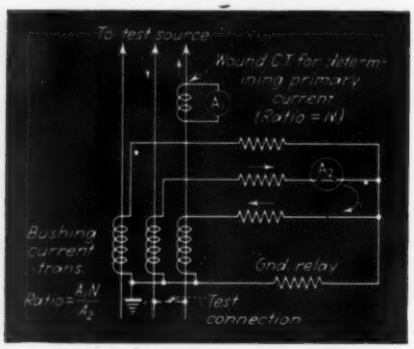


FIG. 1—Method of testing wye-connected bushing current transformers by applying primary current from a low-voltage source. Scheme gives ratio for three-phase or phase-to-phase fault

A method of test that would produce unit current in the transformer secondary and 1.73 times unit current through connected burden would be difficult to obtain and would not lend itself to common methods of bushing current transformer testing in the field. Common methods of testing may be used, however, by passing the same test current through both burden and transformer secondary *providing the value of the burden is modified to give the equivalent volt-amperes per transformer that exist in service.*

While methods have been developed for calculating bushing current transformer ratio, in applications where differential relays are being used and delta-connected current transformers are generally required, it is desirable that the current transformer ratios be determined accurately by ratio tests. Calculations of bushing current transformer ratio require information such as turn ratio,

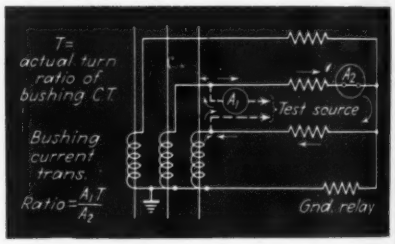


FIG. 2—Method of testing wye-connected bushing current transformers by applying a low-voltage on the secondary. Scheme gives ratio for three-phase or phase-to-phase fault

transformer characteristics, accurate knowledge of the connected burden, all or part of which may not be available. Calculations of ratio do not detect unexpected burdens such as poor connections in the current circuit, change in burdens of devices which may vary from the published data, change in burden due to saturation of the iron in the magnetic circuits of relays and other devices at heavy fault currents. For these reasons it is believed preferable that ratio of bushing current transformer be found accurately by test, particularly where they are delta-connected.

Basic Circuits

Two very common methods of testing wye-connected bushing transformers to determine their ratio, with their normal connected burden, are shown. The method of Fig. 1 connects a source of low-voltage to the primary of the bushing current transformer while method of Fig. 2 applies low-voltage across the secondary leads of the current transformer. Both

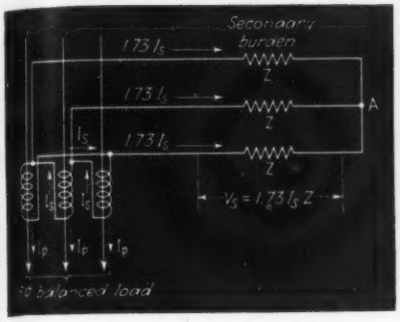


FIG. 3—Load current flow for delta-connected current transformers and balanced three-phase load

these tests simulate phase-to-phase faults, since two bushing current transformers operate in series to supply burden to two phases of the secondary load in series. The equivalent burden per transformer is essentially that of one phase. This is the burden that is imposed on each transformer for a three-phase fault. Hence these methods of test give the transformer ratio for both three-phase and phase-to-phase faults. Since the methods outlined are quite common, no further discussion appears necessary, except to show how they can be modified and extended to determine ratio of delta-connected bushing current transformers.

Use Triple Burden

Next consider the delta-connected current transformers of Fig. 3 for a three-phase balanced load or a three-phase fault condition. If the current in each transformer secondary is I_s, the current through the secondary burden Z will be 1.73 I_s. These three currents add to zero at A, since they are 120 degrees apart vectorially. The volt-ampere burden per conductor is $V_s \times (1.73\ I_s)$. But $V_s = (1.73\ I_s)\ Z$. Thus the burden per conductor in terms of current and impedance is $(1.73\ I_s) \times (1.73\ I_s)\ Z = 3I^2_s Z$. This indicates that if a test current I_s from one current transformer secondary is passed through three times the impedance Z of one phase of the delta-connected burden, the volt-ampere burden will be equivalent to the burden imposed on each transformer for a three-phase balanced load or three-phase fault of the proper magnitude to produce a current I_s in each transformer secondary. Stated another way, the ohms impedance per phase for a delta-connected burden is triple that for an equivalent wye-connected burden. Stated in the form of an equation this becomes $3Z_D = Z_y$ where Z_D is the ohms impedance per phase of the delta connected burden and Z_y is the ohms impedance of the equivalent wye-connected burden.

This triple burden can usually be obtained quite easily by connecting all three phases of the burden in series and connecting it to the secondary of one bushing current transformer as shown in Fig. 4.

Two Circuit Types

Consideration must next be given to the circuit under test in order that the proper burden be selected. Most bushing current transformers that use delta-connected secondaries for differential relaying may be grouped into one of two groups:

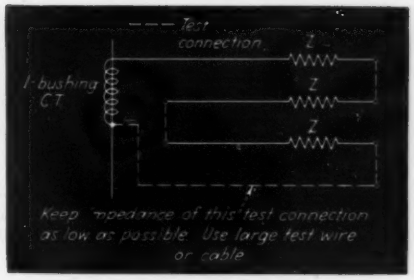
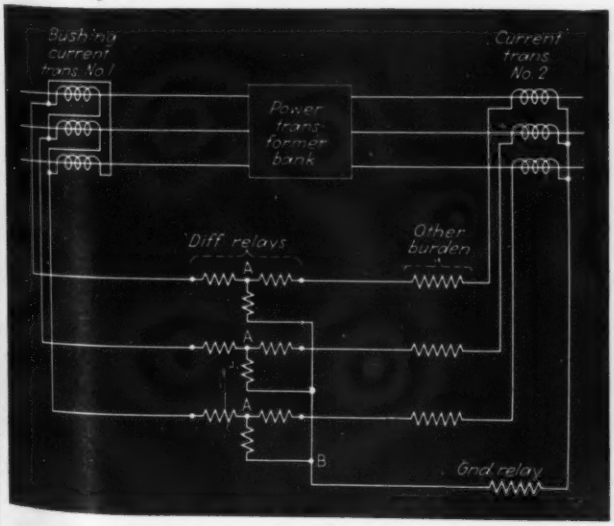


FIG. 4—Method of obtaining equivalent burden per transformer for delta-connected current transformers on a three-phase fault or a three-phase balanced load

Group I: Those where one set of line-current transformers are connected in delta. Such a circuit, in which these current transformers supply one restraining winding of the differential relays directly, is shown in Fig. 5. Other burden in the delta-connected secondaries is usually rare but may occasionally be encountered.

Group II: Those where line-current transformers are connected in wye and a set of auxiliary current transformers provide a delta-connection to differential relays. Fig. 6 illustrates such a case in which the wye connected supply "other burden" in addition to the delta-connected auxiliary current transformers which in turn supply the differential relays. The "other burden" in the wye-connected bushing current transformers may be indicating instruments.

In both these circuits current transformer secondaries from one side of the power transformer bank are interconnected with the secondaries of current transformers on the other side



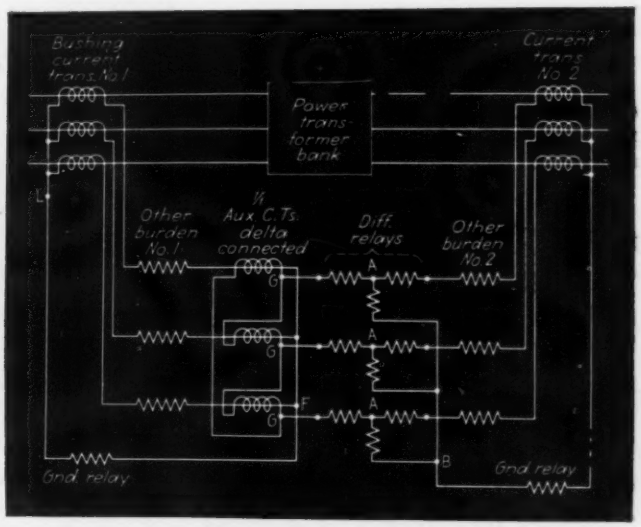


FIG. 5—(left) Secondary current transformer connections for differential relays where one set of line current transformers is connected in delta. FIG. 6—(right) Secondary current transformer connections for differential relays where line current transformers are connected in wye and a set of auxiliary current transformers provide a delta-connection to differential relays

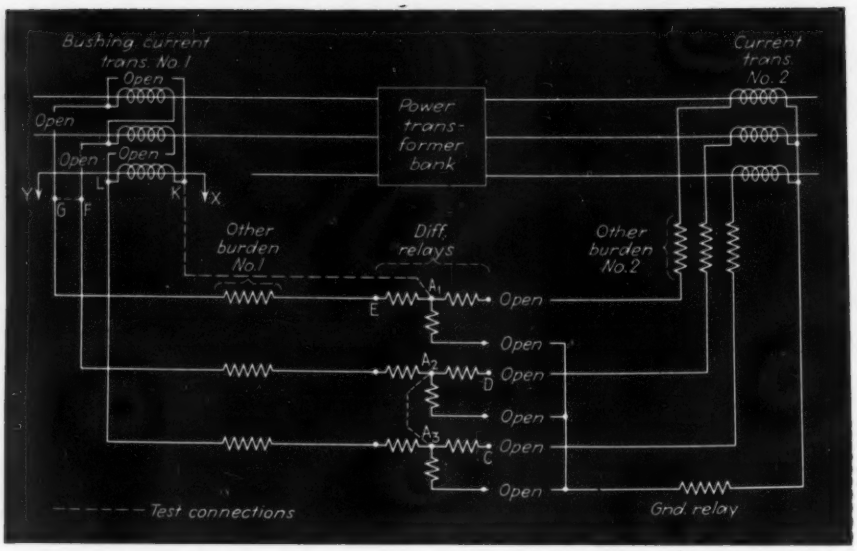


FIG. 7—Scheme for obtaining test burden for ratio determination of delta-connected bushing current transformers where, as in Fig. 5, only one set of line current transformers is delta-connected

of the power bank. These secondaries have a shunt path through the operating windings of the differential relays between points "A" and "B". Any unbalanced current in the circuits due to a difference in the ratios of the current transformers, compared to the power transformer bank ratio, will cause difference current to flow in the operating windings of the differential relays.

This difference current should be kept to a minimum since it flows in the operating winding of the relay. If too large its effects must be counteracted by changing the number of turns on one of the relay restraint windings by changing the tap setting of the differential relays. The circuit of Fig. 5 and 6 may each be considered as consisting of two sets of three-phase currents adding to zero at the neutral point "B". Actually if the current transformer ratios are ideally balanced, little or no current will flow in the differential relay operating windings and the neutral can be considered as being at point "A".

For applications where the tested bushing current transformer ratio does not differ widely as compared to their ideal ratio, the burden division for the two sets of current transformers (No. 1 and No. 2 in Fig. 5 and 6) may be considered to be at "A". If the difference current is large in the differential relay operating windings, the burden of the operating winding should be included as part of the burden on the set of current transformers supplying the difference current.

Burden Connections for Test

The method of obtaining test burden for the case (See Fig. 5) where one set of line current transformers are connected in delta is illustrated in Fig. 7. Purpose of these test connections is to provide an equivalent burden, on the bushing current transformer under test, simulating the burden imposed on it under three-phase fault or three-phase load conditions.

Secondary current for the transformer under test (in Fig. 7) flows around the closed path L-A_3-A_2-F-G-E-A_1-K-L, which includes the secondary burden for all three phases to the points A_1, A_2 and A_3. This is the portion of the secondary circuit that carries the 1.73 times secondary current per transformer during a three-phase fault or a three-phase load condition. This secondary burden for all three phases is being supplied by the transformer under test. With all phases having the same burden it is equivalent to three times the normal burden per phase, during a three-phase load. This represents the desired test volt-ampere burden required as was shown in Fig. 3 and 4. It is assumed that the burden due to the test connections A_1 to K is negligible. This requires that a low-impedance (large conductors) test cable be provided between these two points.

If the points A_1, A_2 and A_3 are not available outside the relay case, a negligible error will result from omitting the test connection A_2-A_3 and applying a connection between points C and D and moving the test connection from A_1 to E. This places a total burden of four restraining windings in series for the differential relays instead of the required number of three, as shown in Fig. 7. Burden of each restraining winding is usually small.

Current transformer connections of Fig. 6 differ from those of Fig. 5 in that the delta-current to the differential relays is supplied from a set of

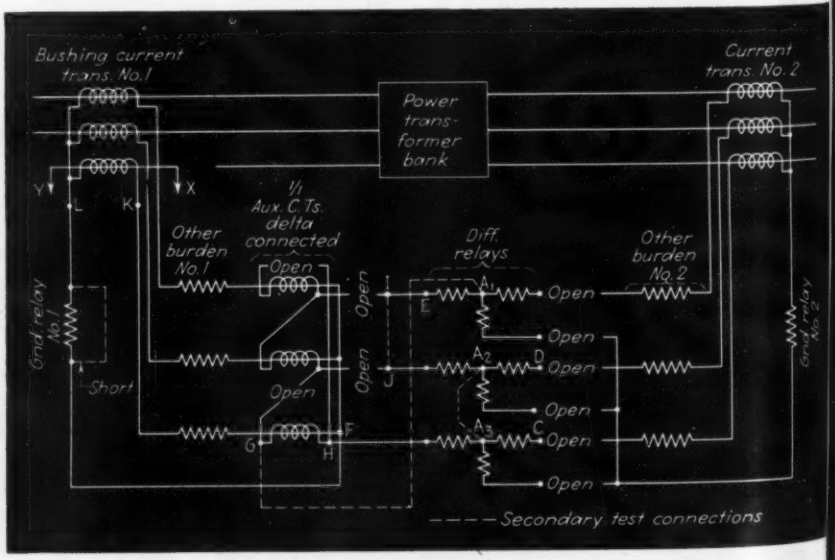


FIG. 8—Scheme for obtaining test burden for ratio test of delta-connected bushing current transformers where, as in Fig. 6, line current transformers are wye-connected and auxiliary c.t's. provide a delta-connection to differential relays. Test source may be applied at X-Y as in Fig. 1 or at L-K as in Fig. 2. Keep impedance of test connections and of neutral to bushing current transformers low

three auxiliary current transformers usually located on the switchboard. The portion of this circuit which carries the 1.73 time normal secondary current of the bushing current transformers during a three-phase fault or a three-phase balanced load is between the delta-connection of the auxiliary current transformers and point "A" of the differential relays.

Test Auxiliary C.T's.

Test burden connections for the case (of Fig. 6) where line current transformers are connected in wye and a set of auxiliary current transformers provide a delta-connection to differential relays are shown in Fig. 8.

Test current for this circuit will flow in the secondary of the current transformer under test around the path *K-F-L-K* and produce a current in the secondary of the auxiliary current transformer, which is in this test circuit, around the path *H-A₃-A₂-J-I-E-A₁-G-H*. During a three-phase fault or a balanced three-phase load the secondary current (Fig. 6) would add to zero at point *F* in the wye connected secondary of bushing current transformers No. 1, since the three-phase currents are 120 electrical degrees apart vectorially and hence no current will flow in the neutral wire *F-L*. The current in the secondaries of the 1/1 ratio delta-connected current transformers between points *G* and *A* (Fig. 6) will be 1.73 times the secondary current in the bushing current transformer under test.

It would be desirable that the test circuit in Fig. 8 have negligible impedance in the path *F-L* since the neutral in three-phase service carries no current. The impedance of this neutral can be kept to a minimum by shorting out the coil of any ground relay through which it passes and by adding either a large test conductor in parallel with it between points *L* and *F* or by paralleling other conductors in the same cable such as the other two secondary phase wires. Obviously if the other two phase wires are used to reduce the burden of the neutral wire *L-F*, care must be taken to make certain the phase wires used for paralleling have no additional burden in them such as relays or transformers between the points of parallel. Also these two-phase wires should be opened at each end beyond the points of parallel to prevent upsetting the rest of the test circuit.

The neutral conductor is often of large enough size that its impedance in the test circuit may be neglected; however, it is important not to overlook shorting out the coil of the ground relay in this case.

The impedance in the secondary of the auxiliary current transformer (Fig. 8) is made up of the path *G-A₁-E-I-J-A₂-A₃-H-G* which is three times the burden imposed on this transformer during balanced three-phase loads which represents the desired volt-ampere burden required. In this path the test connection *G-A₁* should be kept to a minimum impedance since it is not needed to give the desired test burden. This test connection is usually rather short and hence may be neglected as far as its effect on the circuit is concerned. If the points A_1, A_2, and A_3 can not be obtained conveniently, little error will result by omitting the connection between A_2 and A_3 and applying a connection between points *C* and *D* and moving the test lead from point A_1 to *E*. This represents the *CA* relay burden in the test circuit by four restraining windings instead of the desired three.

• • •

"Highlines to Happiness"

"Few people understand the basic financial problems of operating an electric company, although farmers are in a better position to understand these problems than most other business men, because, strangely enough, the operations of a farm and of an electrical company present some striking parallels. Both require a relatively high investment in property and, unlike the average mercantile business, the property is not sold, but rather a return is secured through the use of it. Both electric companies and farms are likely to have annual incomes slightly under 20 percent of the investment in property. In other words, a capital turnover requires about five years in both farming and the electric business. Such items as taxes, labor, fuel (or feed), upkeep and maintenance, and depreciation are expense items common to both industries. Just as on a farm the increased yield per acre reduces the unit cost of production, so does the increased use of kilowatt-hours per customer reduce the unit cost of electricity."

The above-quoted paragraph is from a booklet promoting farm electric service, "Highlines to Happiness," recently published by the Interstate Power Co., Dubuque, Iowa. The booklet is 11¼ in. by 8½ in. in size, 28 pages including covers, and is printed in color. It contains 41 illustrations of farm and farm home applications of electricity, mostly of devices and equipments farmers can make themselves. A feature of the book particularly valuable to the farmer is a page headed "It's Easy to Build Your Own Farm Electrical Equipment" which tells about the great variety of books, bulletins, plans, etc., usually available at no cost from state and federal sources and from equipment manufacturers as well as from the power company. A partial listing of such publications, some 50 of them included, fills out the page.

The text first recites the history of farm electric service in Iowa from its beginning in the pioneering experimental line near the town of Garner in 1924 to the present status of approximately one half the farms in the state having service. The Garner experiment was financed by power companies and manufacturers and operated in cooperation with Iowa State College. The text continues from that start and tells about the values of electricity on the farm and why, as is indicated in the quoted paragraph, farmers should favor electric service from power companies as representing that same free enterprise of which the farmers themselves are as a class such strong exponents. Particular emphasis is laid on taxes, a subject on which farmers usually hold strong views, and the point is made that despite the tax burden on them the power companies give service at rates generally comparable to those offered by cooperatives. Altogether, the content of the booklet is not only useful in promoting farm electric service in practical terms, but also it presents the case of the power companies in a way the farmer readily understands because the same conditions apply in his own business.

Joint Line Evolved for Rural Services

Power and telephone engineers develop details for carrying 7.2-kv. multi-grounded power line and four rural telephone circuits on same 35-ft. poles—Announced as simple, safe, operable and feasible

H. J. SCHOLZ and F. M. CRAFT†*

PRIOR TO THE WAR, the power and telephone companies had extensive programs under way for extending service into rural areas. This work was temporarily curtailed during the war due to the necessity of using critical materials and manpower in the war effort. With the end of the war and the availability of material, the power and telephone utilities are rapidly resuming the extension of their lines to serve many more rural homes. Although many new economies in construction will be employed, this expansion program will entail expenditures of large sums by both the telephone and power companies.

The telephone and power companies have been searching intensively for means whereby their services may be provided within the economic reach of more rural families. One important requirement to the attainment of this goal is the development of less costly methods of communication and power line construction without excessive maintenance expense so that the pole lines may be extended still further into the more sparsely settled areas.

Since the Commonwealth and Southern Corp. in the South and the Southern Bell Telephone and Telegraph Co. operate in the same rural territories, characterized by large areas and relatively low customer density, it was natural for them to collaborate in surveying these areas and to devise ways and means by which they could extend service to more people living in such areas.

Joint pole line construction is not new to these companies, as it has been extensively employed in the urban distribution plant for many years. Heretofore, for several reasons, it has not generally been considered practicable to construct jointly used rural lines. Recent developments, however, in both the power and communication fields, have reached the point where it may be practicable and economical to construct jointly used pole lines for rural service. Some of the developments which now tend to make this type of construction feasible are mentioned in the following.

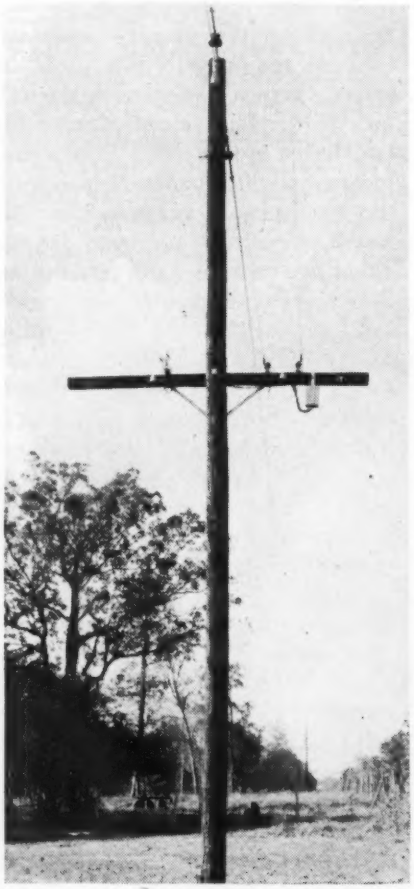


FIG. 1—Typical power pole after telephone circuits were added, showing telephone transposition and protectors and drainage unit mounted on crossarm

Trial Installation

In order to obtain field experience in the construction and maintenance problems which these developments present and to permit tests to determine the feasibility of this type of construction, a trial installation of rural joint use was made in July, 1945, through coordinated efforts of the Commonwealth and Southern Corp. and the Southern Bell Telephone and Telegraph Co.

For the purpose of this installation, an existing rural power line of the Alabama Power Co. in the vicinity of Selma, Ala., was utilized. The section of line selected is approximately 16 miles in length and carries a single phase 7.2-kv. multi-grounded neutral power circuit.

The line consisted generally of 35-ft., class 7 poles, with 197 poles in the route. It was necessary to replace 21 poles to secure additional ground and roadway clearance. The line is situated in the light loading area with an average spacing of 435 ft., and the class 7 poles were of sufficient strength to support the two No. 4 ACSR power wires and at least eight 0.109 high strength steel telephone wires to conform to National Electrical Safety Code Grade "C" construction. Guying was added at corner poles where required to support the load imposed on the pole structure by the addition of the telephone wires. Fig. 1 shows typical configuration.

A development study of expected

* Supervising Engineer, Commonwealth & Southern Corp., Birmingham, Ala.
† Chief Engineer, Southern Bell Telephone & Telegraph Co., Atlanta, Ga.

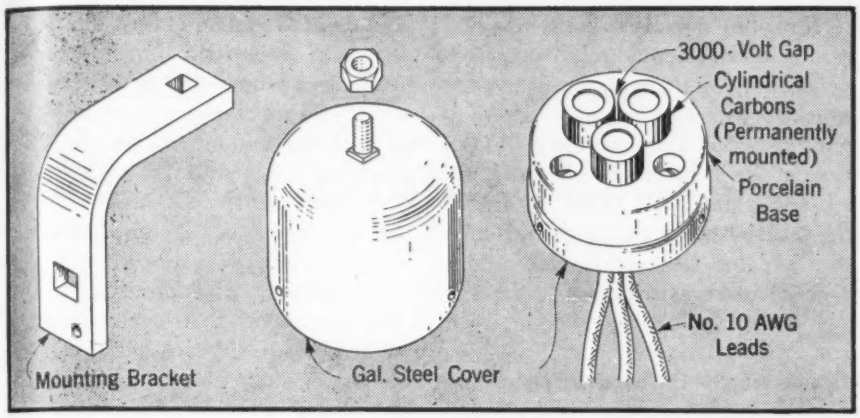


FIG. 2—Open space protector showing symmetrical arrangement of 3-electrode, 3,000-volt gap. Lead wires may be used interchangeably for connecting to ground and to telephone wires. Units installed at approximately ½-mile intervals

telephone users was made in the area served by the existing power line, and it was determined that the expected ultimate need would require stringing four circuits for a distance of 3 miles, two circuits an additional distance of 7.5 miles and one circuit for a further additional distance of 5.5 miles to the end of the route. For the purpose of the trial installation, only three circuits were placed for the first mile and two circuits for the next 3 miles with one of these extending for 12 miles more to the end of the route. However, crossarms were placed to accommodate the expected ultimate needs.

Standard 4-pin, 6-pin and 10-pin telephone crossarms were installed in the several sections of the line to care for the estimated ultimate needs for one, two and four circuits respectively. These arms have 12-in. pin spacing which was considered necessary to provide adequate wire separations for the spans concerned. In order to maintain the required 30 inches climbing space, the pole pins of the 10-pin and 6-pin crossarms were not used; and on the 4-pin crossarms, used for an ultimate of one telephone circuit, both wires were attached to the same end of the arm.

Safety Code Conformity

For this type of power circuit, the National Electrical Safety Code requires a minimum vertical separation of 40 inches at the pole and 30 inches at mid-span at a temperature of 60 deg. F. and no wind. In the case of long span construction, however, it is also necessary that consideration be given to the line of sight between the points of attachment of the telephone conductors as compared with the lowest point of sag of the lowest power conductor. This is necessary to guard against the possibility of contact during telephone stringing operations and maintenance repair work. For this trial installation, it was decided to maintain the line of sight between the points of attachment of the telephone wires at a distance of at least 5 feet below the primary power wire at mid-span and at least 1.5 feet below the neutral power wire at mid-span under conditions of initial sag of the power wires. To meet these requirements the telephone wires were in general attached 5.5 feet below the neutral, with increased separation being provided where required because of longer spans.

Protectors, Drainage

In addition to the normal protection at the subscribers' stations, supplementary protection was provided by the installation of open space protectors (Fig. 2) installed on each telephone circuit at approximately one-half mile intervals. In case of contact between the power and telephone wires, these protectors will discharge to ground at approximately 3,000 volts. The grounding conductor used for the protectors is connected to the multi-grounded neutral. Computations indicated that, using this arrangement, the power circuit would be de-energized in a very few cycles, in case of contact, through operation of the power circuit breakers. The coordinated protective devices in both the telephone and power supply circuits make this installation, from a safety standpoint, comparable to joint use with lower voltages.

Since undesirable potentials would be impressed on the open wire telephone circuits due to electric induction, it was necessary to give consideration to some method of drainage in order to hold these potentials within satisfactory limits. It was decided to use a condenser with a balanced mid-point tap (0.125 mf. to mid-point) for this purpose. A condenser of this type was bridged across each telephone circuit at approximately 2.5-mile intervals with the mid-point grounded to the multi-grounded neutral of the power system. To avoid serious impairment in the transmission of the telephone circuit, matched 10,000-ohm resistances were inserted on each side of the ground connection. Carbon blocks were installed in parallel with the condensers and resistances to protect the drainage unit from damage due to lightning or power contact. Fig. 3 illustrates this drainage unit as assembled for the trial installation.

With this drainage arrangement, the open circuit voltage to ground on the sixteen-mile telephone circuit as measured at the cable terminal pole was approximately 80 volts and when connected through the entrance cable to the central office, it was further reduced to 40 volts. When the circuit was terminated in a balanced long-line circuit installed at the telephone central office the induced voltage was again reduced to approximately 11 volts.

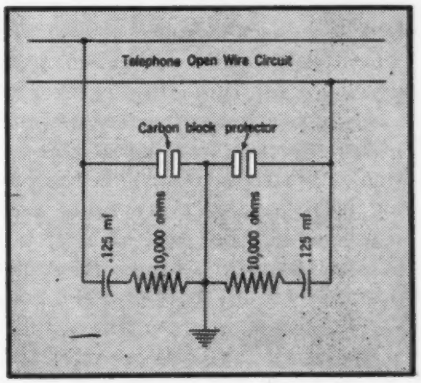


FIG. 3—Drainage unit consists of matched condensers and resistors with mid-point grounded. Carbon block protector guards against lightning damage

Erection Safety

During construction the telephone wires were laid out on the ground and later placed on the crossarm to minimize the possibility of their being flipped up into the power wires. The wire reels were grounded throughout

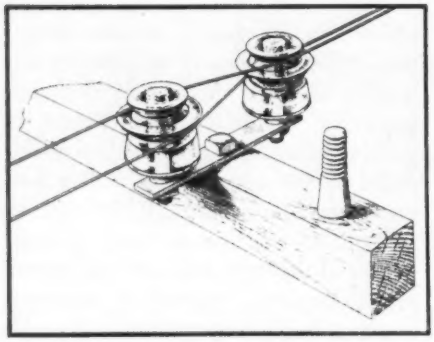


FIG. 4—New "point" type transposition bracket with wires in place. Insulator ties are not required on these brackets. Small additional wire needed

the pulling operation, and the wire was pulled across temporarily grounded transposition brackets or across a grounded conductor placed temporarily along the top of the arm at scattered points. This was for the purpose of reducing to a minimum the induced static charge on the telephone conductors during the pulling-in period. Similar grounds were kept on the wires at scattered locations until permanent drainage devices could be installed.

New Transposition Bracket

Transpositions were placed in the telephone circuits in accordance with a new transposition design which was developed for rural line construction and which may also be used on other exchange open wire lines. This design consists essentially of transposing each pair at every other pole. However, in order to limit cross talk between adjacent circuits, the transpositions on any two adjacent pairs are "staggered" so as to fall on different poles. If the poles are numbered consecutively, this will result in transposing one-half of the circuits on the even numbered poles and the other half on the circuits on the odd numbered poles. To limit cross talk in non-adjacent circuits certain transpositions are omitted at about 2-mi. intervals. Because of the simplicity and uniformity of the design, it can be easily laid out and installed by the construction forces without requiring any specific engineering. In addition, it will not be necessary to keep detailed records of the locations of transposition points, and circuit extensions may be made by merely continuing the transposition scheme without regard to basic sections.

In order for this transposition scheme to be economically practicable in rural line construction, it was necessary to develop a relatively inexpensive "point" type transposition bracket (Fig. 4). Since the length of wire required to transpose with this type of bracket is relatively small, for span lengths in the range of 450 ft. the transpositions can be thrown after the wire has been tensioned in long sections without readjusting the sag.

Electrically balanced telephone central office equipment and telephone sets having very low admittance unbalance to ground were used in order to minimize the effects of telephone unbalances on noise. The sets used on this trial line were equipped with a 3-element cold cathode tube in the connection to the ringer which is normally grounded. The control gap of this tube is bridged across the line and the subset ringer is connected through the main gap to ground. In the case where a telephone subscriber was also a power customer, the interconnecting of the power and telephone grounds provided very low grounding resistance through the multi-grounded power system neutral, an arrangement which is advantageous from both the ringing and safety standpoints. Tests indicated the noise induced on the telephone circuit to be very low with tube sets and balanced central office conditions.

Feasible Joint Construction

In conclusion, it appears that this joint-use method developed by the Commonwealth and Southern Corp. and the Bell System on this line of the Alabama Power Co. is a technically feasible method of providing both types of rural service in many cases. It provides a good talking circuit. It requires few modifications of existing equipment and these can be quickly installed as soon as men and materials are available. It will conserve materials and labor. The safety requirements both for telephone personnel and telephone subscribers can be easily met. Channels are already established whereby new projects can be considered and cleared, through established coordination committees.

This method will probably not be suitable in all types of situations. Certain subscriber densities and locations may require other methods. Development proceeds with rural telephone service using carrier systems over power wires. There is also the possibility of using carrier on the telephone lead and this is being investigated. The use of radio telephone service is still another possibility. All these methods of providing telephone service are being considered in addition to the familiar open wire line and, in some sections, buried wire or cable may even supplant this.

While the economics of this particular type of construction have not been fully worked out, it seems to offer sufficient promise of having a valuable field of application to justify continued work and additional trials and experience.

• • •

Russia Builds Solar Power Plant in Asia

First tangible results of industrial utilization of solar energy will appear shortly when a new-type solar converter begins supplying power to the Tashkent Cannery at Tashkent in Russian Asia.

Finishing touches are now being put to two experimental industrial converters of solar energy designed by Dr. Frederice Molero, of the Power Institute of the U.S.S.R. Academy of Sciences and the institute's solar energy group which he heads.

Methods have been worked out for producing huge paraboloidal mirrors capable of achieving high concentrations of solar energy with installations that do not require any extraordinary degree of precision to manufacture, and of producing steam at all temperatures and pressures required in industry. This will enable plants to go over to solar energy without installing new steam power equipment which is expensive to operate.

A mirror with a surface of 80 square meters has already been manufactured for the factory in Central Asia, where shipment of fuel involves big expense, which produces vegetable oils. Dr. Molero claims that he will be able to build mirrors many times larger in the near future. He also plans to combine several such gigantic mirrors to further increase their power.

Silicone Resins for Electrical Insulation

Properties significant where thermal aging or excessive moisture rule —Superior thermal stability removes temperature aging as limit in machine design—Lower weights, higher temperature, longer life, better moisture resistance are potentialities—Not a panacea, however

GRAHAM LEE MOSES, Westinghouse Electric Corp., East Pittsburgh, Pa.*

SILICONE RESINS offer great possibilities of overcoming one of the primary limitations of electrical insulation. It is the consensus of opinion of those engineers engaged in the development and application of silicone insulation that:

1. Silicone insulation offers a temperature advantage of 50 to 75 deg. C. over conventional Class B insulation.

2. Silicone bonded and treated insulating materials are usable with minor variations in conventional processes (mainly in baking temperature) where properly selected and applied.

3. These silicone materials may be applied where thermal aging or excessive moisture are serious problems. It has been generally recognized that insulating materials constitute the weakest parts of electrical machinery. They are mechanically fragile and are readily susceptible to physical damage and thermal degradation. Thermal aging is probably the primary factor in determining insulation life as it renders insulating materials vulnerable to physical damage from the effects of normal operation.

Silicone resins may be used to bond and treat mica, asbestos and fibrous glass to produce composite insulations with superior thermal aging properties. The evidence indicates that the use of silicones in this combination improves the thermal stability of insulation to the point that temperature aging need no longer be a basic limit in machine design. The operating temperature of electrical insulation has long been recognized as the limiting factor for machine design and application in industry standards but there are other factors which sometimes out-weigh temperature.

Electrical insulation employing silicone resins has two outstanding properties, namely:

1. Ability to withstand relatively high temperatures for longer periods of time than any previously known similar materials.

2. Excellent moisture resistance which is retained for relatively long time especially during cyclic operation at high temperatures.

It should be recognized that silicone insulating materials are outstanding only in these properties. In other regards they are generally comparable to widely used conventional materials. These conventional materials may frequently have better individual properties than the silicones in certain other respects. The general conception that silicones are a panacea for all insulation troubles should be avoided as this may result in misapplication where conventional materials are actually better suited.

Potentialities of Application

Engineers may utilize silicone insulating materials in one or more of the following ways:

1. To reduce size and weight of apparatus, where these are based on temperature limitations.

2. To enable operation under abnormal ambient temperature conditions.

3. To increase insulation reliability and life where conventional temperature standards are employed.

4. To improve moisture resistance beyond that obtainable with conventional materials.

The name "Silicone" has been applied to a class of new chemical compounds whose molecular structure is built upon a framework consisting of a silicon-oxygen chain. These compounds lie between glasses and silicates and organic plastic materials. The silicone class of materials is very broad and includes widely different types of materials from thin liquids to greases and resins. Silicone chemistry is so new that organized research has only "scratched the surface" and the future possibilities for new and better silicone products are tremendous. The research chemists indicate that silicone products may be possible paralleling the physical properties of most of the hydrocarbon family.

Synthesis of Silicones

The silicone compounds thus far in production and use have very interesting and useful temperature characteristics. They are resistant to oxidation and chemical change at elevated temperatures, and many of them have less physical change (such as viscosity) with temperature than conventional materials. Silicone compounds can be said to be made from brine, coal, sand and oil as sources of the basic constituents but their synthesis involves numerous steps

* Manager, Development Insulation Section A. C. Generator Engineering Department.

and involved industrial and chemical technical processes. Fig. 1 traces the general steps in the processes involved in the manufacture of silicone compounds as follows:

a. Sand is the source of the silicon atom which when heated with coke (from coal) and chlorine (from brine) forms silicon tetrachloride.

b. Organic chlorides are made from hydrocarbons derived from coal and oil by treatment with chlorine (from brine).

c. Magnesium metal (also from brine) aids the reaction by which organic chlorides are attached to the silicon. This reaction replaces chlorine atoms from silicon tetrachloride with a hydrocarbon radical, to produce the variety of organo-silicon chlorides.

d. Treatment of organo-silicon chlorides with water removes the chlorine and by-produces magnesium chloride to form silanols.

e. The silanols condense with each other, building up long chain molecules in the same manner as phenol-formaldehyde resins.

Liquid silicones were one of the first silicones to reach commercial production. These materials have interesting electrical characteristics but are not generally applicable to electrical machinery.

Silicone Varnishes

Silicones for electrical insulation are primarily used in the form of insulating varnishes. They are used for bonding composite insulation, treating cloth, impregnating coils and windings and surface coating electrical and mechanical structures. These resins are made in two types. The most generally used is similar in its general physical properties to the common oleo-resinous varnishes. These silicone varnishes are available in form quite similar to those widely used in the electrical industry and are used in the same manner as conventional materials except baking temperatures. Currently available silicone varnishes must be baked at 200 to 250 deg. C. The second type of silicone is comparable to the thermo-setting resins used for making laminates. These two types of silicone resin permit bonding and treating a sufficient variety of insulating materials that complete machines can be made using high temperature silicone insulation throughout.

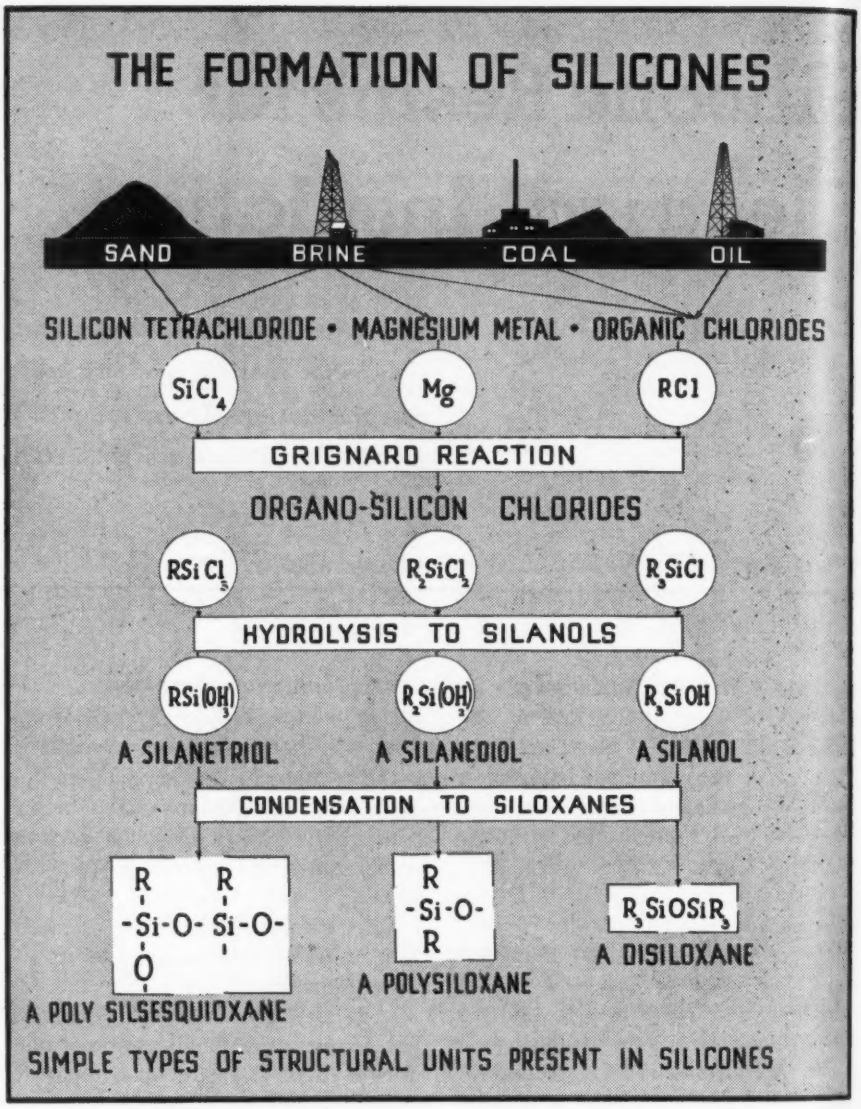


FIG. 1—Process of formation of silicones from basic constituents

It has been demonstrated that a minimum of organic materials should be used with silicone resins as the baking temperature required for the currently available silicone resins destroys the organic materials. Furthermore, composite insulations should be prebaked at elevated temperatures before treatment with silicone resins to prevent gassing and bubbling. It has, therefore, been necessary to develop a complete new line of insulating materials employing only mica, fiber glass and asbestos bonded with silicone. In the absence of an AIEE classification, these materials are called high temperature silicone (abbreviated to HTS) insulation.

It is relatively easy to demonstrate the superior thermal stability of a silicone varnish film by comparing it to an organic varnish film or glass cloth and aging them at some elevated temperature. Most such crude tests will show a factor of 20 to 1 up to 500 to 1 in favor of the silicone resin. For actual quantitative values a modification of the ASTM flexing life or heat endurance test is to be preferred. In this test a 0.002 thick film of varnish is coated on each side of a 0.005 thick metal panel. After aging at temperature the end point is determined by bending around a $\frac{1}{8}$-in. diameter mandrel. (Cracking of the film is the sign of failure). The results of a series of such tests are shown in curve Fig. 2. These include one of the better organic varnishes (an alkyd-phenolic) and the silicone varnishes. The great superiority of the silicone varnishes as well as the improvement in the flex life of the recently developed silicone varnish is clearly shown.

To compare the moisture progress and thermal stability of class B and HTS insulation, two groups of a.c. stator coils were insulated in an identical manner in all respects except

that organic resins were used in the class B coil and silicone resins in the HTS coil. Glass insulated wire was used, and glass backed mica wrapper and tape were used for ground insulation with glass finishing tape. All coils were varnish impregnated. Coils were first immersed in water and subsequently aged at 200 deg. C. and again immersed in water. The insulation resistance data reported in curve Fig. 3 were observed after one hour in water one minute after application of voltage with a 500-volt, d.c. megohm bridge. The superior initial moisture resistance of the HTS coils is shown by the initial difference and the rate of change clearly indicates the difference in thermal endurance.

In order to determine the thermal endurance of HTS insulation on actual machines, numerous accelerated life tests have been made. In all cases moisture resistance of the insulation has been used as an indicator of life as it is felt that maintenance of the important property is an essential factor. Following are two of the early tests that are of great interest. More tests are underway on a more elaborate scale and preliminary results confirm earlier tests.

Early in 1942 a totally enclosed fan cooled induction motor was wound using the best available Class B insulating materials employing glass and mica. It was prebaked at 250 deg. C. and then treated with silicone resin varnish. A series of engineering tests was made which included full load temperature run, overload run for 13 hours at 300 deg. C., and peak overload test during which 500 deg. C. total temperature on the winding was observed by thermocouple. These tests were followed by an accelerated life test on the insulation during which the motor winding was operated at 210 deg. C. rise by resistance (250 deg. C. hot spot temperature) for 3,376 hours. The motor was dismantled and examined periodically and the winding was subjected to a high humidity test. The test was ended by a bearing failure resulting in damage to the winding. The failure resulted in molten aluminum running over the winding with relatively little damage to the insulation. Subsequent examination disclosed that the insulation was still in operable condition.

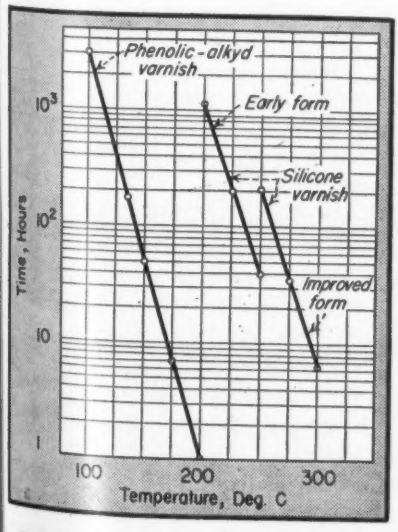


FIG. 2—ASTM. flexing life at various temperatures for phenolic-alkyd varnish and silicone varnishes

Auxiliary Generator

One three-phase auxiliary generator was made with HTS insulation throughout the stator. Over 100 stator coils were made of this type for various tests. The stator coil consists of 2 parallel 0.114 by 0.162 double-glass-covered silicone-treated wires, 3 turns per coil, 2 coils per slot (approximate section $\frac{7}{16}$ inch by $\frac{1}{8}$ inch with 9 inch straight part). This generator was given a preliminary temperature test with the stator short circuited at $2\frac{3}{4}$ times normal current resulting in an observed stator winding temperature of 355 deg. C. for 6 hours. Subsequently the stator was redipped and baked and it was operated on accelerated thermal aging test. The test consisted of operating at normal speed as a generator with the stator heated on alternate days to obtain thermal cycling. The observed rise by resistance on the stator winding was 210 deg. C. resulting in an estimated hot spot temperature of 250 deg. C. This test was continued for 2,966 hours with the stator winding heated to 210 deg. C. rise as observed by resistance. At the end of that time the insulation was still in satisfactory and usable condition. The winding was then subjected to severe humidity test, with subsequent high potential and running test. Then it was given a short circuit test at full voltage. Finally the winding was high potential tested to break down.

Silicone insulating materials have limitations which must be considered when applying them. They require high temperature baking for relatively long times to develop their maximum physical and chemical characteristics. Unless properly processed they may not have sufficient abrasion resistance or oil-proofness. In this connection it must be recognized that these characteristics of the currently available silicones are not as good as certain organics. However, they are equivalent to many widely used organic materials, and are suitable for most applications in these respects. Use of silicones in connection with organic materials should be avoided unless the organic materials are prebaked at 225 deg. C. to remove all volatile gases before treating with silicone varnish.

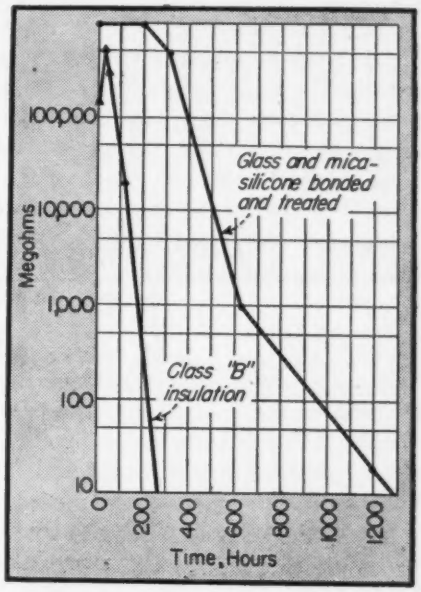


FIG. 3—Comparison of moisture resistance of typical a.c. generator coils with Class B insulation and HTS insulation. Insulation resistance values were after 1 hour immersion in tap water

It has been recommended that the AIEE recognize the availability of this new class of insulation and assign some new classification or designation. The suggested temperature limits are 175 deg. C. hot spot corresponding to the 130 deg. C. limit in AIEE Standards No. 1 for class B insulation. This would allow 120 deg. C. rise by resistance above a 40 deg. C. ambient with 15 deg. C. allowance to hot spot.

Numerous applications of silicone insulation are being made on a limited scale and the results of these applications will be used to guide the development program. It is therefore important that this new material be applied only where its use is justified by service requirements.

Electric House Heating Load Characteristics

Limited test and record data of performance in Northwest indicate that addition of heating to residence load shifts peak to morning hours and significantly reduces load factor

HARRY G. KELSEY, Manager, Cowlitz County PUD, Longview, Wash.

LACK of complete and reliable information on the load characteristics of electric house heating that is based upon a sufficient number of installations to justify conclusions finds utilities and serving agencies of the Pacific Northwest eagerly seeking data upon which to base rates and policy in order to meet a growing public demand for this type of service. Here in Longview we have 60 electric space-heating installations in individual homes, duplexes, motel cabins and small commercial buildings, upon which considerable data have been secured. These data, while acknowledged to be limited, are offered for what value they may have as a contribution to the knowledge on this very timely subject.

Heating costs have been tabulated for 38 individual electrically heated homes for the past two years. A summary of results for the year 1944 is presented in the accompanying table. Since all service is supplied through one meter per customer it was necessary to determine the energy used for heating purposes only. This was done on the basis of a statement of the U. S. Weather Bureau that only one percent of the fuel consumption for heating a home during the entire year is used during the 3-mo. period of July, August and September. On this assumption four times the kilowatt-hour consumption and billing for that 3-mo. period was considered as the annual consumption and revenue from lighting, cooking, water heating and miscellaneous uses, and subtracted from the annual consumption and billing, and the remainders considered as kilowatt-hours consumed and billing for electric space heating in individual homes.

There may be a question as to the accuracy of this method and for purposes of checking, submeters were installed on five installations to measure heating energy alone. It was found that during the year 1944, the calculated heating consumption was 8.3 percent below the actual, and that calculated heating cost was 4.3 percent below actual. However, for estimating purposes it is felt that the calculated method is sufficiently accurate because usage for all purposes is controlled by the occupant, and living habits vary to such an extent that individual cases will of necessity vary from the averages.

Before presenting test data, a word about type of house, insulation, method of heating and wiring cost. All installations except two were made in homes while under construction. Regular standard frame wall construction was used, sheathed on the outside with shiplap covered with building paper and siding or shingles, and wood lath and plaster inside covering. Exterior walls and upper ceilings were insulated between studding with 4 in. of Palco wool in all of the houses except two, which were only ceiling-insulated. Average cost of insulation was $100. Felt paper was placed between the sub-floor and finished floor. If more than one story, felt paper was used only in the lower floor. All exterior doors and windows were equipped with metal interlocking weatherstrip.

Wall-type Wesix heaters were installed in each room, each thermostatically controlled. Individual thermostatic control is very important to the utility to obtain the greatest diversity of demand. Heater cost averaged $18 per kw. Houses vary in size from 4,032 to 17,664 cu. ft., and connected heating load ranges from 6 kw. to 31 kw. In general, connected load averages about 2 watts per cu. ft.

Heating outlets were wired for 230-volt service. Average cost per outlet varied from $10 to $12.50. Heaters were recessed in the walls for flush mounting. Outlet costs include a proportionate share of the main service entrance distribution facilities. All electric service is supplied through one self-contained socket-type meter.

The utility operator is particularly interested in the effect of space heating load on system demand and equivalent customer demand on the distribution transformer. Through the installation of graphic meters on primary feeders, data were obtained determining the equivalent customer demand for various percentages of space heating saturation and range and water heating saturation. These meters were installed covering the 12-mo. period from July 1, 1944, to June 30, 1945.

One feeder served 76 homes having 91 percent saturation of electric ranges and storage-type water heaters and 22 percent saturation of space heating. The yearly maximum demand occurred on Friday, December 15, 1944, between 7:30 and 8:00 a.m. Equivalent demand per customer was 3.16 kw. Undoubtedly space heating materially influenced the demand since it occurred in the morning on one of the four coldest days of the year.

One secondary served ten homes

having 100 percent saturation of electric ranges and storage-type water heaters and 70 percent saturation of space heating. The yearly maximum demand on the primary side of the transformer occurred also on Friday, December 15, 1944, between 7:30 and 8:00 a. m. Equivalent demand per customer was 6.9 kw.

Another secondary served ten homes having 100 percent saturation of electric ranges and storage-type water heaters but no electric space heating. The yearly maximum demand on the primary side of the transformer occurred on August 14, 1944, during the evening, probably due to the water heating load. The equivalent demand per customer was approximately 1.9 kw. The maximum winter peak occurred on December 26, 1944, between 5:30 and 6:00 p. m. The equivalent customer demand was 1.7 kw.

Demand Much Increased

These values will be of interest to the distribution engineer, as they show a substantial increase in customer demand when space heating is added. They also show a definite change in the time of day when the demand occurs. Load curves of seven space heating installations combined for the week of March 4 to 10 inc., 1945, show conclusively a morning heating peak and an afternoon heating peak. Excepting Wednesday, March 7, the morning peak exceeded the afternoon peak; however, the time of the afternoon space heating peaks coincides with the afternoon peaks resulting from lighting, cooking and water heating.

The same seven heating installations were included in a group of ten customers, three without electric heating, served from one transformer. Another set of daily load curves for the week of December 10 to 16 inc., 1944, taken on the primary side of this transformer, shows a morning peak on three days, an afternoon peak on three, and a noon peak on one (Sunday). Thus it may probably be assumed that the addition of heating tends to give residence load a morning peak.

From the tests made the conclusion might be drawn that without electric heating the maximum winter demand per customer would be in the neighborhood of 1.7 kw. and would occur in the evening. With 22 percent saturation of space heating the customer demand on the system would increase to about 3.2 kw. and would probably occur in the morning. Increasing space heating saturation to 70 percent would increase the customer demand to 7 kw., which also would occur in the morning, although there was evidence of a possibility that it might occur in the evening.

If diversified system demand per customer for space heating only were to be taken at 5.3 kw., as indicated by the tests, then annual load factor for this load would be 22.5 percent. With 7 kw. as diversified demand per customer for *all* service, annual load factor would be 29.3 percent. Load factor without electric heating, based on a demand of 1.7 kw. per customer, would be 50.4 percent.

On our system, due to many influencing factors we are in effect buying energy for this type of load on a rate that at present does not exceed 2½ mills per kw.-hr. The average annual resale rate for this service is about 6½ mills, leaving a 4-mill margin to cover other elements of cost. The average price received by us from the sale of energy to all classes of service is only about 5½ mills due to the large volume of industrial load. The average space heating rate is higher than the present over-all average price. We have been able to meet all of our operating costs including bond interest and amortization charges and believe that we can continue to do so. However, it should be pointed out that at present we are serving only approximately one percent of our residential customers with electric heating.

Analyzing the additional investment in one primary and secondary line occasioned by serving seven electrically heated homes, we found this added investment to be $158, comprising the added cost of heavier secondary wires and larger transformer. The additional annual revenue from these seven heating installations totaled $384.67, or a ratio of $2.43 of annual revenue per dollar of additional investment.

Analysis of Electric Heating for 38 Homes
Year 1944, Longview, Washington

House	No. of Rooms	Cubic Feet	Connected Heating Load Kw.	Total Electric Service Kw.-Hr.	Total Electric Service Billing	Portions Chargeable to Electric Heat Kw.-Hr.	Portions Chargeable to Electric Heat Billing	Electric Heat Kw.-Hr. per Cu. Ft.	Average Annual Cost per Cu. Ft.
1.	5	5,700	9	15,238	$125.14	8,670	$54.18	1.52	.95¢
2.	6	7,632	15.5	18,940	151.04	10,728	71.64	1.41	.94¢
3.	5	5,816	12.5	16,793	135.52	9,721	61.96	1.67	1.07¢
4.	6	9,980	30	22,036	175.75	15,084	102.83	1.51	1.03¢
5.	6	8,000	17	17,654	144.88	13,398	85.00	1.67	1.06¢
6.	7	9,512	18	19,018	132.40	12,466	61.52	1.31	.65¢
7.	6	10,500	21	23,175	185.87	18,335	123.39	1.75	1.18¢
8.	3	4,032	6	12,126	103.07	5,314	30.87	1.32	.77¢
9.	6	9,216	9	14,292	122.68	10,168	64.12	1.10	.70¢
10.	6	8,000	17.5	11,318	99.79	7,234	40.63	.90	.51¢
11.	5	9,200	10	19,686	158.06	13,726	90.26	1.49	.98¢
12.	5	6,900	15	14,316	126.25	9,004	61.77	1.30	.90¢
13.	6	9,672	11.5	20,629	164.09	11,005	77.41	1.14	.80¢
14.	5	6,680	10.5	17,930	146.64	10,446	64.92	1.56	.97¢
15.	5	7,200	12	21,002	165.47	9,538	67.83	1.32	.94¢
16.	7	8,832	20	22,541	170.36	11,217	74.88	1.27	.85¢
17.	6	7,200	15.5	16,165	133.42	8,985	59.34	1.25	.82¢
18.	7	11,888	20	21,379	170.23	11,491	82.19	.97	.69¢
19.	5	7,544	17	20,194	158.82	8,910	63.58	1.18	.84¢
20.	6	8,100	16	17,500	141.10	10,180	66.30	1.26	.82¢
21.	5	6,908	15.5	14,434	118.64	7,022	43.36	1.02	.63¢
22.	5	7,000	15	13,921	118.12	9,729	58.28	1.39	.83¢
23.	7	9,600	20	24,664	195.24	11,220	80.20	1.17	.81¢
24.	6	9,698	16.5	21,288	169.84	13,568	93.00	1.40	.96¢
25.	5	7,824	19	14,755	122.98	10,183	60.86	1.30	.78¢
26.	6	8,320	15	21,681	170.97	11,253	79.29	1.35	.95¢
27.	7	13,000	20	21,741	175.00	15,321	103.40	1.18	.80¢
28.	6	9,800	19.5	11,801	100.37	4,497	25.65	.46	.26¢
29.	5	9,160	16.5	10,595	95.79	6,783	37.03	.74	.40¢
30.	6	6,480	15.5	21,232	168.80	12,796	88.24	1.97	1.36¢
31.	5	6,780	14	16,185	130.60	8,789	55.36	1.30	.82¢
32.	5	6,880	15	21,355	167.00	9,087	65.52	1.32	.95¢
33.	5	6,528	11	20,095	158.61	9,659	67.77	1.48	1.04¢
34.	5	6,900	9	17,975	143.01	8,667	58.01	1.26	.84¢
35.	5	7,167	15	18,557	146.53	10,165	66.21	1.42	.92¢
36.	5	5,104	11	13,065	108.25	7,353	41.69	1.44	.82¢
37.	5	6,400	12	18,755	148.89	8,131	57.09	1.27	.89¢
38.	8	17,664	31	19,075	168.71	17,767	120.87	1.01	.68¢
Totals			**393.5**	**683,106**	**$5,517.93**	**397,610**	**$2,606.45**		
Average 6		**8,232**	**15.5**	**16,976**	**145.21**	**10,463**	**68.59**	**1.27**	**.83¢**

All houses are weather-stripped, doors and windows, and all have wall and ceiling insulation, except No. 5 and 15 which have only ceiling insulation.

Preparing and Repainting Outdoor Electrical Equipment—I

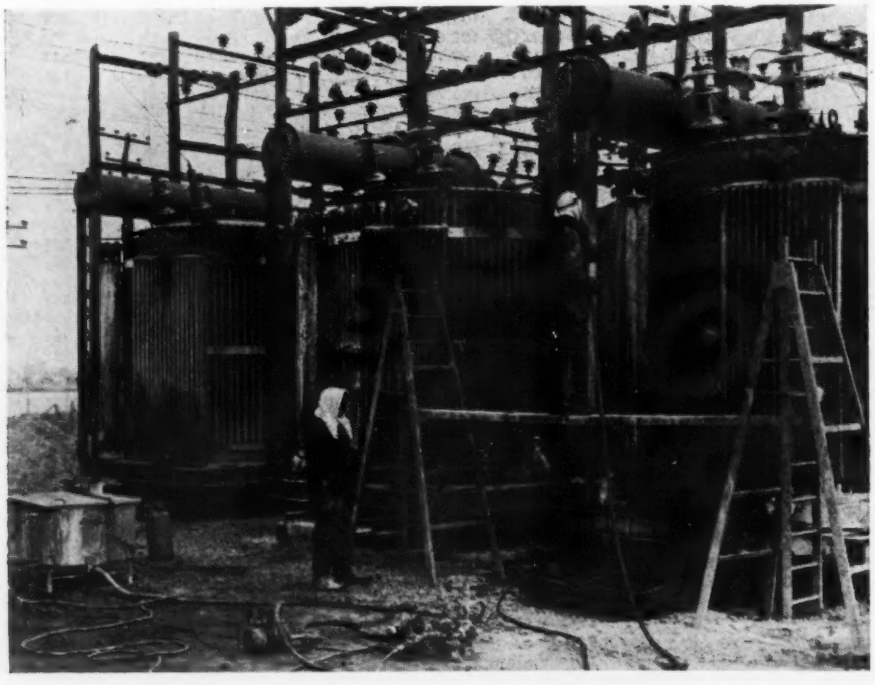
Economic protection of structures and equipment to preserve life and maintain good appearance requires engineering planning and supervision for good results—Surface preparation, safety precautions, paint selection and application are of vital importance

E. B. CURDTS, The Narragansett Electric Co., Providence, R. I.*

THE ECONOMIC protection of metal inclosed outdoor electrical equipment against rust and discoloration is one of the utility maintenance engineer's most difficult problems. Steel bus structures, chain link fences, oil circuit breakers, switch houses, transformers, regulators and many other devices embodying ferrous metals require paint originally or for preservation and good appearance, exposed as these often are to public view. The general problem centers upon (a) preparation for repainting; (b) choice and application of the new paint.

Paint life depends greatly on relatively costly surface preparation. Recent years have seen some improvement in outdoor equipment design and finish which has lessened upkeep burdens to a degree. Reduction of oil leaks, better surface preparation, higher quality paint and improved factory application techniques have helped greatly. However, older equipment (bought say 15 to 30 years ago), still with us in large quantities, was inadequately designed in many cases with regard to accessibility of all painted areas or the elimination of water pockets where paint cannot endure. If any piece of outdoor equipment is designed to shed all water, all painted surfaces being accessible, properly painted or galvanized, and made oil tight at the factory, preservation and appearance then depend on setting up a well organized cleaning system and applying a very light refinishing spray or flow coat of paint at the right time. The timing of this refinishing work is vitally important, and the one factor most often neglected. It is assumed that any mechanical damage to the original paint has been promptly cared for.

* At the time this article was prepared, the author was Superintendent of Substations and Maintenance for the Narragansett Electric Co. He has since become Applications Engineer for the J. G. Biddle Co., Philadelphia, Pa.



HOT STRIPPING A BANK of three 3,333-kva. transformers

Life of Galvanized

Our experience indicates that the life of hot-dipped galvanized coating on metal chain link fence is eight to twelve years. Such a coating should and does last longer on bus structure steel, except on upper flat horizontal surfaces. Here the coating will start to fail in about twelve years, and where invisible from below, bad rusting usually occurs before preventive measures are taken. Even in the best modern paints surface color and luster will deteriorate long before the paint film itself. Where equipment is frequently repainted for appearance, the condition of the original paint film (with a good bond) need cause no worry; but these brightening coats must be applied extremely thin to prevent a heavy build-up of paint film. An original 3-coat system is beneficial in providing two remaining coats to protect the metal when the finish coat has

almost chalked away. Where the original coats have failed from inadequate preparation, neglect or age, it may be advisable in some cases to remove all the paint and start over again. Both mechanical and chemical methods of stripping may be necessary. Long life of paint cannot be expected unless the metal surfaces are chemically and rust-clean, though certain paints or preservatives give reasonably good service over active rust or rust which has been chemically treated. Clean surfaces are free from oils, greases, alkalies, acids and active rust.

SANDBLASTING DEFECTIVE PAINT from the mechanism housing of a 25-kv. oil circuit breaker

Surface Preparation

Hand scraping tools, sand paper and electric disc sanders for spotting work are generally useful where the paint surface needs only washing, cleaning a few small spots down to bright metal, spot priming and applying a light finish coat. Large defective areas may justify the use of power-driven chipping hammers and wire brushes, though these are ineffective on rust pits, deep corners and crevices. High-speed, air-driven, wire, rotary brushes involve some hazards to operators from loose or broken bristles and risk from clothing contacts. A weak solution of trisodium phosphate in water is preferable to mineral spirits because of the latter's cost and inflammability, using about 1 oz. by weight per gal. of warm water and washing later with clean water.

Where paint failure is general, the paint film too brittle to maintain a bond or where large areas are too hard to reach without destroying paint on the more accessible areas, complete stripping of all paint may be necessary. Here hot or cold paint removers are useful, these consisting of caustics sometimes having binders to increase surface adherence. These removers can be purchased prepared, or "home made." An example of the latter is to add 2 to 4 lb. commercial caustic soda per gal. of water to make the stripping batch, adding it slowly with a long handled shovel and stirring with a long paddle. Care must be used in adding caustic to an already hot batch, as the caustic reacts rapidly with the water and a high temperature results. A wetting agent is then added in the ratio of about 2 fluid oz. per lb. of caustic, the batch being stirred and then heated to an approximate boiling point.

The hot strip method is most effective. To work as cheaply as possible, some special equipment is needed, though if later painting is done by the flow method, part can be used there. Aside from the usual scaffolding the equipment consists essentially of a portable vat or tank for heating the stripping liquid, a pump with bypass valve for flow control at varying heads for delivering from tank to job, salvage pans, a return pump to the heating tank, and hose. A ready built 100-gal. insulated tank with kerosene torch equipment costs about $160, and is useful even on rather large transformers. Motor-driven gear pumps of 10 to 20 gpm. generally work well with 1-in. rubber hose. The shower bath type of nozzle spray head is good, especially in stripping backs of transformer boiler tube type radiators.

The stripping process should be a continuous cycle of applying, salvaging and reheating the liquid until all surfaces are covered, repeating according to the number of paint coats to be removed. The subsequent applications wash off softened paint and apply fresh, hot, stripping material to the remaining coats. The process may occasionally be stopped long enough to remove softened paint with high-pressure water. Local areas of "piled on" paint, if any, must be given extra treatment to remove thick curtains. Caustic is effective on most paints except those with an asphalt base and possibly some of the more modern synthetics. While some of the old paint removed in the foregoing process will recirculate with the stripping liquid, most of it will settle out in the heating kettle. A replenishing stock must be added to the kettle as the work proceeds, as all the liquid applied cannot be salvaged.

Safety Precautions

Rubber hats, boots, coats and gloves should be worn by anyone handling the liquid, as well as a transparent face shield covering neck and ears and designed to swing upward from the face. A dilute water-vinegar solution or similar mild acid should be at hand to neutralize any caustic that may accidentally come in contact with human skin. Petrolatum rubbed on face, hands and neck by workmen at start of day helps.

A disadvantage of caustic is that it will not remove rust, which is often present and usually inaccessible where old paint must be removed. A weak solution of phosphoric acid neutralizes metal alkalinity after using caustic, but some maintenance engineers feel that because of the relatively high resistance of some of the more modern synthetic paints to alkalies, the careless use of neutralizing acids may leave the metal surface in an acid state more harmful to the paint bond than the possibly alkaline condition. This assumes that neutralizing acids do not cause an immediate complete reaction with the metal. In either case the job may be washed well with water and dried before painting. It appears that a metal surface pH between 5 and 10 may offer a fair compromise between extremes when dilute phosphoric acid is used as a metal treatment. The final phosphoric acid treatment used by us before painting has a pH of about 1.6.

Some effective and reliable commercial compounds or chemicals are

available for metal cleaning and treating before painting. These usually consist of phosphoric acid and possibly butyl or ethyl alcohol, water being used in the field to control strength. Some formulations remove heavy oil and grease, some dissolve or deactivate heavy rust, and others remove light oil and/or light rust, followed by a more dilute solution of the same chemical with a reaction between metal and acid. In the case of a non-oxidizing acid like phosphoric it reacts with the iron which is above H_2 in the activity series, forming ferrous or possibly ferric phosphate and liberating H_2. With rust, the reaction forms ferric phosphate and liberates water. The reactions follow:

For steel

$$2Fe + 2H_3PO_4 \rightarrow 2\,FePO_4 + 3H_2\uparrow$$

ferric

For steel

$$3Fe + 2H_3PO_4 \rightarrow Fe_3(PO_4)_2 + 3H_2\uparrow$$

ferrous

For rust

$$Fe(OH)_3 + H_3PO_4 \rightarrow FePO_4 + 3H_2O$$

ferric

With iron and steel, liberation of H_2 will occur only if the hydrogen-ion activity exceeds that corresponding to a pH of about 4.3. The reaction or hydrogen liberation is more vigorous with some steels than with some irons, due probably to relative purity. Very pure metals or homogeneous alloys often possess a surprising resistance to acid reaction.

Usually the above phosphoric acid treatment is allowed to dry unwashed before painting. When the metal is dry a white-blue ferrous and possibly a white-yellow ferric phosphate salt surface precipitate may appear. Only slightly water soluble, these salts can be removed by retreatment in the original phosphoric acid, with water wash before the metal becomes dry; but these salt precipitates are unobjectionable and paint can be applied through them without ill effects. Hot caustic has some objections for paint removal use because some types of paint are immune to its attack; unpleasant working conditions and contamination of adjacent structures and equipment from spatter and drip. Liberal use of drop cloths helps greatly. Even sandblasting to strip paint shares some of these drawbacks, and liquid caustics can be flowed or sprayed upon areas of some types of equipment inaccessible to sandblasting.

Use of Sandblasting

Sandblasting prepares metal almost perfectly for repainting, as it mechanically cleans deep accessible rust pits, cracks and crevices. In some cases thick, flexible paint must be flame-treated to burn and carbonize it to a brittle state in removing it. Undue lapse of time between blasting and painting may aggravate conditions of moisture or other chemically active invisible contaminants remaining in deep pits or cracks on outdoor equipment. Where oil seepage locations appear after blasting, supplementary chemical treatment may be required. As metal is in a raw and vulnerable state after blasting, the equipment should be repainted or chemically treated immediately.

A blast machine of about 3-cu. ft. abrasive capacity, and using air at from 20 to 80 cfm. at 75 psi., depending on nozzle diameter, suffices for most paint stripping jobs on electrical apparatus. A portable air compressor with hose and nozzles need be allocated only in part to paint stripping, from the fixed charges and depreciation angles. A protective mask for the operator is essential to completely safeguard the head, provide good vision and clean cool air for breathing. A machine of the above capacity costs around $160. A well-designed abrasive and control valve with mixing chamber is needed to eliminate waste of abrasive and maintain blasting efficiency. Air-fed head gear may cost about $50. Operating costs include that of the air compressor, together with the abrasive, blast hose and nozzle replacement.

Fine Sand Scatters

The most serious objection to sandblasting paint from outdoor electrical equipment in light and power stations is the scattering of fine sand particles over wide areas, particularly in the direction of the wind. This objection is three-fold. First, the dense clouding around the operator makes it difficult for him to see how to clean thoroughly in restricted areas with minimum hand motion, and how to avoid excessive abrasion to thin metal areas. Second, with the wind in the wrong direction certain adjacent establishments or neighbors may find the sand dust objectionable. Third, the operation of adjacent outdoor electrical equipment or apparatus in buildings in the same yard such as relays, instruments or rotating machines may be affected by the sand dust. The two latter objections can be met to a degree by working with the prevailing wind and using canvas curtains around the job, and in the case of station buildings, openings in these structures can be temporarily covered. All three objections can be partially eliminated by the proper choice of sand and careful adjustment of the blast machine control valve, so that a maximum cutting action will result from a minimum discharge of sand. Sand may be purchased which has been prepared for this work, having been washed, screened to remove "fines" as well as oversize particles, dried and put up in 100-lb. sacks for easy handling and storage. The removal of the light-weight fines helps to reduce sand dust migration beyond the job area. Although the use of steel grit would definitely increase cleaning speed compared with silica sand, its economic advantage is questionable in view of the impracticability of salvaging a high percentage of the grit in outdoor operations, and the danger of its use in the vicinity of energized electrical equipment.

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Improving Disconnects

In an eastern central station the existing 8-blade, 3,000-amp, sub-cell disconnecting switches were replaced by 4-bladed silvered 3,000-amp. disconnects having 3-in. studs. New lower oil circuit breaker bushings with 3-in. studs were installed. Contact on the new disconnects was made by two silver strips bearing on a silver surface on each side of the lower blade. Trouble was experienced in obtaining uniform contact. To get a true surface the contacts were run on a face plate, as filing was unsatisfactory, the life of the disconnect being considerably reduced by corresponding loss of silver. A satisfactory method of installing the silver contacts proved to be the application of mercury to both copper and silver, after which the unit was placed in a heat press. The strength of the resulting bond exceeded that which would have been secured by brazing.

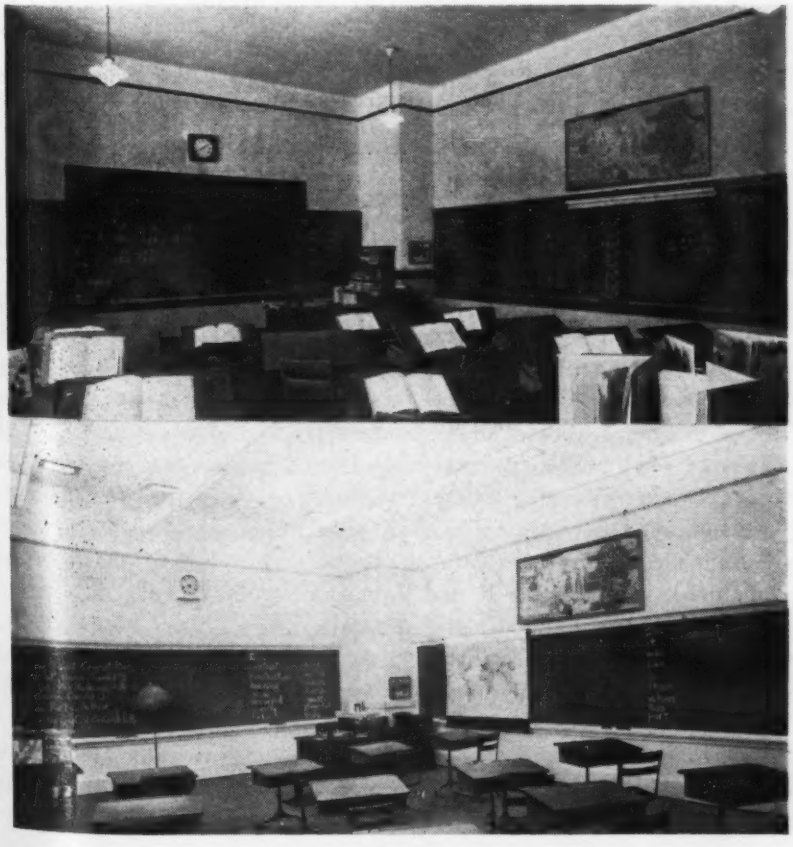
Saves Eyesight of School Children

Modern sight-saving room in Poughkeepsie school combines fluorescent tubes for general illumination with chalkboard incandescent lighting

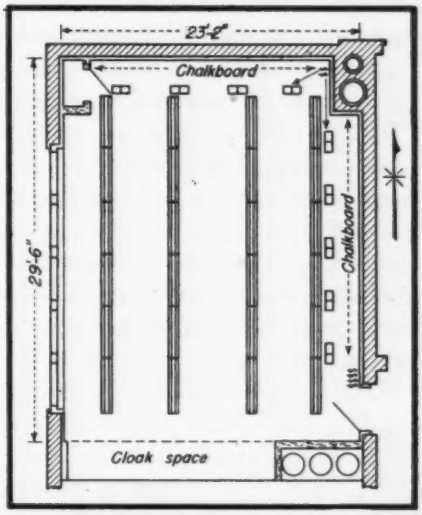
TAYLOR M. BARR, Central Hudson Gas & Electric Corp.*

THE EDUCATIONAL AUTHORITIES in the City of Poughkeepsie have recognized the need for ideal seeing conditions in the school system. The child with extreme subnormal vision has been given special consideration. In one of the schools a sight-saving room is maintained for their use. All of the latest types of equipment that will aid children with subnormal eyesight have been provided. These children are transported from various parts of the city to this school, where they carry on their lesson preparation, not only from specially designed large type text books but also from chalk board instruction. In this sight-saving room a specially trained teacher familiar with sight saving methods has the responsibility of instructing these children in using the facilities provided. The eye specialist and the physicians of the school system continually follow the progress of these children. Every effort is made to give them the same opportunity as that of the child with normal vision. The result of this project in this room has been most gratifying, since these children have shown creditable progress when placed in an ideal surrounding.

*Lighting Engineer, C.H.G.&E. at Poughkeepsie, N. Y.



The general lighting in the room is furnished by Ainsworth "Spacialite" fluorescent troughs and the special incandescent fixtures installed flush in the ceiling above the chalk boards. This lighting is used on especially dark days when additional lighting is needed for chalk board instruction. The general illumination after four hundred hours' use is 53 foot-candles in the study area of the room. The average illumination 30 in. above the floor in the room on the Illuminating Engineering Society's basis of calculation is 47 foot-candles. The highest brightness in any part of the room is well below any maximum permitted for ideal seeing conditions.



UPPER PICTURE (at left) is of room before installation of new lighting which is shown in lower view. Each of the four rows of fluorescent takes 600 watts; the nine incandescent flush units in front of the chalkboards, 200 watts each. The connected load is thus 4,200 watts; illumination is 53 foot-candles

The flat white finish of the ceiling is carried 30 in. down the sidewalls. Below this drop ceiling the wall is painted with a specially prepared flat green pastel shade which has a 70 percent reflection factor.

The chalk boards are standard green glass with a 40 percent reflection factor. Extra large chalk sticks are used for legibility on the boards. All of the desk furniture is finished with flat varnish which eliminates specular reflections. The desks are movable and can be placed in different locations in the room for ideal seeing conditions. A typewriter with specially large type is used for typing up instructions for the children.

Editorials

S. B. WILLIAMS, *Editor*

Transfer of Ownership Isn't Just Peanuts

WHEN ONE READS in this issue the report of the testimony of the chairman of the Securities and Exchange Commission before the House Interstate Commerce subcommittee, one may get the impression that the transfer of private utility holdings to public ownership so far is just peanuts. So why all the shouting?

Three hundred millions may be just peanuts to bureaucrats working in the realm of billions, but we would like to point out that the transfer of the entire State of Tennessee and the entire State of Nebraska to public ownership isn't peanuts. Likewise, we would like to point out that the current efforts to transfer ownership within the states of Washington and Arizona aren't just more peanuts.

When the SEC chairman indicated that the incentive to public demand for acquiring ownership was considerably lessened as the result of improved operations of utilities under federal security regulation, he was merely closing his eyes to the existing conditions. It is true that local public relations are improved over what they were ten years ago when the Utility Act was passed and the demand from the public for transfer of ownership is not so prevalent, but the tax incentive is still strong. Now it offers through transference an opportunity to private owners to get a larger realization on their holdings without diminution of return. This is a much more powerful incentive than any crusade for public protection.

Maybe it's only peanuts when the government lost between $65 and $70 millions in federal income tax payments during the last eight years as the result of utility ownership transference and each year the amount has been getting progressively larger until this year when the total lost tax revenue would be $17 millions. It was one thing when the consuming public got this, but now the gravy goes to private security owners, speculators and promoters.

It is this condition that SEC is powerless to prevent because it is barred from jurisdiction over transfer to public ownership, yet if it exercised the same control over transfer price as it does when ownership remains in private hands, it would find no incentive for the Guy Meyers type of transfer financing because there could be nothing it it for anybody but the public. But then, when the opportunity to make big money at the public expense is involved it is difficult to find anyone caring about the public. And why should there be when SEC, FPC, Treasury and everybody else set up to protect the public, encourage that very thing by their tacit acquiescence? Talk about Daniel in the lion's den! He was safe compared to the public facing the private security owner eagerly looking toward a big price and the big speculative promoter who sees a clean-up, while the guards hope the kill will be over soon.

Starting Currents for Compressor Motors

A SIGNIFICANT EVENT HAS OCCURRED in the field of negotiation between utilities and manufacturers. It is significant because of the promptness with which agreement was reached. Seldom has an issue of divergent objectives been resolved so amicably, so quickly and so effectively.

It is further significant because it paves the way for full cultivation of the market for room air conditioners. Members of the Air Conditioning and Refrigerating Machinery Association have been urged by the association to agree that the motors applied on these devices for home use will be 230-volt motors if the corresponding 115-volt motor would draw more than 40 amp. in starting. In turn, the members of Edison Electric Institute are being urged to alter their service rules so that locked rotor currents up to 40 amp. will be sanctioned.

Of course, the fixing of the 40-amp. limit in no sense eliminates the flicker problem—it does, however, alleviate it and fix its boundaries. Above all it allows the power companies to concentrate on the other facets, one by one.

English Association Expresses Women's Viewpoint

IN COMMENTING upon the attainment of age this fall by the Electrical Association for Women (England) *The Electrician* points out that at the outbreak of the war there were some 9,000 members in 80 branches, being mainly housewives, teachers and demonstrators. Nothing like it exists in the United States. Attempts have been made at different times to organize the women of the industry and considerable progress was made during the days of NELA. At present we have the Electrical Women's Round Table of New York City and little or nothing else of that nature.

The English approach apparently has been different from anything we ever tried here because it includes housewives and teachers. One of the results is that it can and does express the opinion of women on all electrical matters in which they are interested. What an asset it would be for us to have some place where we

could have the woman's viewpoint uncolored by commercial considerations! What a wonderful opportunity such an organization might be to create a better public understanding of the industry!

Of course, such an organization would have to have a guiding spirit who was somewhat unusual in that she, not he, could command attention. The English society has such a person in Miss Haslett who played an important war role in England that grew out of her association work.

So many of our industry programs are directed by and to women, it would appear that we might well afford to study what England has been doing so well for the past 21 years. It might have something very valuable to us in the next decade or so.

How to Get Needed War Surplus for Engineering Schools

LOCKED UP in warehouses in this country and abroad are millions and millions of dollars worth of engineering equipment belonging to the armed services that has a limited commercial market but is badly needed by our engineering schools. Some of this equipment was used in these very schools as part of the service training programs and returned to the government as soon as the programs were ended.

What can be done to release as much of this equipment to our engineering schools as is needed? If these schools were in devastated areas the problem would probably take care of itself automatically, or if one of our allies needed the equipment for its schools satisfactory arrangements could probably be made. Home folks, however, seem to be stumped.

Right now men are returning to the colleges in increasing numbers and by early spring these institutions will be taxed to their utmost not only in quarters and faculty, but what is most serious, in demonstration and laboratory apparatus. This equipment, therefore, is needed now. Without it the colleges will necessarily have to restrict enrollment to the facilities available.

It would seem to us that the engineering schools ought to find some way to present their case collectively to the Army, Navy, Surplus War Property Administration and Congress, showing their needs and how much more they can do in satisfying post-war education demands if this equipment is made available to them. To try to break it loose one by one may take too long a time, whereas group action and publicity might bring results fairly soon.

If this country can spend billions on lend-lease to others, surely it can find a way to release some of its surplus to build up its future manpower back home. If the schools do not get this equipment now it will probably stay locked up somewhere waiting for another war, when it will be found to be useless.

For a change, let's invest a little in future Americans.

Unloading Coal Cars

GETTING COAL OUT of the railroad cars is not such a bad task when the coal is dry. But when it is wet or frozen it can become an irksome matter. Steaming and dumping by upside-downing is the nearest approach to the ideal over-all answer but few except the larger coal users can justify the investment in car dumpers.

Hopper cars constituted a big advance when they were introduced. But sticky coal does not always flow out of them as was intended and then manual effort has to be applied to free the clinging portions. In brief, coal cars are not perfect so when the railroads resume their program of designing superlative cars for passenger travel they might also encourage improvements in coal cars so that they will empty with minimum assistance and persuasion. "Whamming" with bars and sledges ought to be unnecessary; if rendered unnecessary along with supplementary shoveling, the cars would make more mileage between trips to the repair shops. If nothing can be done to improve the cars themselves, then there is an even better field for mechanical unloading devices that can achieve the same objectives.

Much real progress has been made in recent years in handling coal by conveyors, buckets, skips, bulldozers, tractors and trucks after it has been taken from the cars or barges. A similar degree of progress in the configuration and implementing of the cars themselves would assuredly be welcomed as an offset to rising costs and the continuing difficulty of hiring and keeping workmen that are content to do such menial tasks.

A New Quality of Purchased Power

ONE OF NEW YORK'S LARGEST HOSPITALS, being beset by a strike of maintenance men, is on pins and needles for fear the power plant men will walk out. So long as the power remains on, the hospital can continue to function.

It seems strange in these days of labor strife that any institution, store, factory or office building would continue in a situation where a small group of employees could cripple the entire operations. Even in those rare instances where purchased power costs more it would almost seem as though the continuity that accompanies central station service would be worth any slight differences in cost.

Of course, power companies are also vulnerable to labor disturbances but in the extreme cases where service is cut it is never off for long because the public will not stand for it. This freedom from interruption from labor disturbances didn't just happen. Both management and labor have grown up to regard service continuity as sacred.

It's an ill wind that can't blow some good, so maybe a new quality value will be placed on purchased power as work stoppages spread.

WASHINGTON COMMENT

By R. N. LARKIN, Washington Correspondent

Bombing Survey of German Power

IT IS HARD TO READ the passages devoted to electric utilities in the report of the United States Strategic Bombing Survey without getting the feeling that the opposite of about everything therein was encountered by the power companies in this country during the existence of the Office of War Utilities and its predecessor organizations.

The Nazis, it seems from the report, did just about everything wrong as far as electric power is concerned, while the opposite was the case over here. Giving the devil his due, the Nazis performed thus ineptly amid showers of high explosives and fire bombs, while the Office of War Utilities had no such distraction to complicate its problem.

Never a Bombing Target

The utilities section of the report, drawn up under the direction of W. E. Mitchell, president of the Georgia Power Co., notes, with what seems an air of sadness, that "the German electric power industry was never made a primary target for bombing." A number of important generating stations were severely damaged through the slop-over of bombs aimed at precision targets nearby, but the Royal Air Force aimed only 532 of its 1,235,609 tons of bombs at identifiable power targets, and the Eighth Air Force only 316 of its 688,000 tons. For what comfort it may bring plant owners and managers now condemned for the rest of time to an atomic world, that enthusiastic boast we have been hearing about our bombardiers "putting a bomb in a pickle barrel from 10,000 ft." wasn't wholly accurate. The survey showed that, on an over-all basis, only 20 percent of our bombs aimed at precision targets hit the target areas, although the one-month record, compiled last February, was 70 percent. A target area is a circle having a radius of 1,000 ft.

Germany went into the war—after four years in which it confined most of its capacity additions to central and eastern regions, away from the heavily industrialized but exposed western border areas—with a power shortage severe enough to have caused curtailments even before shooting started. Early war days saw no attempt to boost capacity because a short war was anticipated. Later attempts to get capacity in operation were insufficient to keep up with the shortage, which soon necessitated a continuous 10 percent curtailment that rose higher than 30 percent during peaks. "The extensive transmission system was practically valueless in overcoming the general energy supply shortage. . . ," the report notes.

With domestic and small shop consumption only 10 percent of output when the war began, efforts to conserve in this category, including frequency and voltage reductions, were fruitless. Shifts to off-peak working hours and several other measures saved 5 percent of peak demands, "not nearly sufficient to meet the shortage." Further curtailments had to come out of war production.

Curtailment Program

"Considerable disagreement developed over priorities of curtailment between districts and individual industries," the report states, "which led to the misuse and eventual disruption of the curtailment program. Demands became such that operators were not permitted to shut down for maintenance purposes, which, in due time reacted unfavorably to greater plant output. . . . The German electric power situation was in a precarious condition from the very beginning of the war and became more so as the war progressed. . . . The losses of electric energy caused by bombing did not produce a greater economic effect only because there was an equal and greater loss of demand caused by the aerial bombing of industry."

The German power system was vulnerable to bombing attack because of the "continuous, critical energy shortage," the lack of reserve capacity, the "relative ease" with which generating and transmission capacity can be damaged and the "relative" difficulty of restoring it, "the inability to transfer any appreciable amount of current, and thus to shift power losses," and the "absolute dependence" of industry on electric power.

Survey agents inspected 23 generating plants, which made up about one-third of the so-called German "grid," or integrated system, which, at the end of 1944, accounted for 13,300,000 kw. of Germany's 22,000,000 kw. Of these 23 plants, 14 had been damaged by bombing.

Vulnerability

"An analysis of the attacks on these stations," the report asserts, "leads to the conclusion that a density of two-tenths of a ton of bombs per acre of plant area in all instances disrupted operations for a period of weeks or months, and that a density in excess of four-tenths ton per acre made restoration a matter of six months to a year or longer."

"Plant utilities—electricity, gas, water and steam—were found to be vulnerable to air attack," the report notes, adding that despite installation of lines in trenches, severe damage was inflicted by direct and near hits. Normally, damage to plant utilities as a result of bombing was about equal to that inflicted on the plants themselves.

The Germans were far more concerned over attacks on one or more of their basic industries and services—their oil, chemical or steel industries, or their power or transportation networks—than they were over attacks on their armament industry or city areas," the report states. "The most serious attacks were those which destroyed the industry or service which most indispensably served other industries. The German experience showed that . . . no indispensable industry was put permanently out of commission by a single attack. Persistent re-attack was necessary."

NEWS OF THE WEEK

'35 Holding Company Act Heard by Supreme Court

Quorum of 6 Justices Finally Found to Determine Constitutionality of 'Death Sentence' Clause—Past Record of Court Indicates Law Will Be Upheld—Attorney Denies Holding Companies Control Utilities

Just a decade after the issue was fought laboriously through Congress in one of the most publicized legislative battles of modern U. S. History, the Supreme Court undertook last week to determine the constitutionality of the "death sentence" clause of the Public Utility Holding Company Act of 1935.

Only six justices sat on the nation's highest bench on November 15 as the first of nine hours of argument was made by Charles Evans Hughes, Jr., son of a former chief justice of the United States. Four of the six were appointees of Franklin D. Roosevelt, all of whose influence with Congress, at a time when he was at the height of his peace-time power, was required to obtain enactment of the legislation now at bar. Three other justices, all Roosevelt appointees, were absent because of self-disqualification.

Presence of only six justices added to the prospect that the appeal from the death sentence, brought by four holding companies, would be denied, for, since the clause has already been held constitutional by inferior courts, it will take a majority of the sitting justices to overrule the finding. A 3-3 decision on the present combined case would not upset the lower court rulings. Such a split is believed possible although more or less improbable by court observers. That justices Murphy, Rutledge or Black could find against the constitutionality of the death sentence on the basis of their past records of staunch adherence to the New Deal is not seriously believed.

Most widely known of the five cases combined in last week's argument was that of the North American Co. vs. the Securities and Exchange Commission, a case which had been before the court for almost three years without action for want of a quorum that was only obtained last Spring with the removal of a self-disqualification against Chief Justice Stone, and which quorum was almost lost with the resignation last Summer of Mr. Justice Roberts, who was replaced by former Senator Harold H. Burton of Ohio.

Combined with the North American case were those of the Engineers Public Service Co. vs. SEC, and vice versa, as well as the American Power & Light Co. and the Electric Power & Light Co. vs. SEC. North American and Engineers had been ordered to divest themselves of all but specified operating companies under section 11 (b) (1). A.P.&L. and E.P.&L. had been ordered to dissolve under Section 11 (b) (2). SEC joined the party in an attempt to obtain the reversal of that section of a circuit court decision which, while it upheld the act, found minor fault with SEC's application of it and ordered minor adjustments.

Basically at issue in each case was the constitutionality of Sections 11 (b) (1) or (2), although even if these sections were overthrown, their demise would only come after a considerable portion of the job they had been intended to do had been done—and beyond hope of recall.

Mr. Hughes, whose father headed the court when much New Deal legislation was accepted or rejected, opened the argument as counsel for the North American Co. He was opposed on behalf of the government by Solicitor General J. Howard McGrath.

Hughes told the court that while the act was founded upon the power of Congress to regulate interstate commerce, the sections at issue did not contain a single test relating to interstate commerce, did not, in fact, even mention the words. The act, he went on, prescribes no rule for commerce under which a holding company is specifically held to be in interstate commerce and contains no findings as to the effect on interstate commerce of holding companies nor any as to the appropriateness of the means devised to regulate such effect.

Hughes then expounded North American's second contention—that SEC erred when it held that the company was more than a mere investor in securities and does actually control the operations of the operating companies whose securities it owns.

Stock Voting not Control

Hughes told the court that mere voting of stock and election of directors is not "a badge of control," but is rather a "normal incident of investment." He said that investment did not constitute interstate commerce, and that SEC must make positive findings, rather than merely presume that stock ownership by North American resulted in control of operating companies. While detailed findings were present in the Electric Bond & Share case under the Holding Company Act, Hughes asserted, none had been made in the North American case, and the only finding of any sort by SEC was to the contrary of the position it took in its order divesting assets valued at $190,000,000. He then quoted an SEC report that North American leaves operations and operating policy to its subsidiaries.

Hughes went on to attack constitutionality of Section 11 (b) (1) under the fifth or "due process" amendment. He described the act as retroactive, adding that "there is no question as to

its deprivation of property." It deprives investors of the right to pool investments and to obtain diversification of them, he said, and destroys values by forcing disposal of properties at times other than of its own choosing. Hughes argued that remedies must not be out of balance with the offensiveness of the defect to be remedied if the due process clause is not to be offended, and declared that the dissolution and divestment remedy outbalances the holding company evil. Most of the ends the act seeks to achieve are obtained without such drastic measures as those of 11 (b) (1) and (2), he said.

McGrath declared that North American is typical of the companies the act sought to reach and describe it as beyond the practical reach of state regulation. With relation to Hughes' contention that North American is not in interstate commerce but just owns securities, he said the company owns 80 other companies in 17 states, serving 165,000 square miles of the nation and 3,000,000 customers. Twelve million people obtain utility service of some sort from North American subsidiaries, he said, asking:

"How can we say it is not in interstate commerce when every act it performs is performed with relation to a company outside New York State, where North American makes its home?" Sale of securities is a North American function performed in interstate commerce, McGrath said, describing security sales as comparable to the sale of any other product in interstate commerce.

North American, he said, may have convinced itself that it does not control its operating companies, but "ownership itself is control." The company, he argued, effectively controls operations, rates, and everything else its operating companies do through the election of directors who in turn choose the managers. The angle which has most interested North American in its purchase of securities, he said, is voting control. McGrath then quoted a North American vice-president as having testified before SEC that "we have assisted our subsidiaries to a considerable extent," and a vice-president of the Wisconsin Electric Power Co. as having testified that "we are in constant contact and consultation with officials of the North American Co."

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Purchases 650-Kw. Unit

Sandersville, Ga., municipal plant has purchased a diesel engine and 650-kw. generator. Present capacity of the plant is 700-kw.

Salesmen Told to Sell Company with Service

More important than selling electric service is selling the company that supplies it, said George E. Whitwell, vice-president, Philadelphia Electric Co., at the first post-war meeting of the Interstate Power Club in New York, November 19. Selling the company he told the assembled power salesmen, includes selling its service, and they should look at and handle their work in this larger aspect.

A lucid exposition of basic factors in applications of induction heat was made by E. J. Rothsack, electronic department, Allis-Chalmers Manufacturing Co., and David Moffatt Myers, of Myers, Fuller & Addington, set forth a consulting engineer's viewpoint on private plant competition with central station service in the post-war years. The meeting closed with a movie of variable speed control of a.c. motors presented by U. S. Electrical Motors, Inc.

New officers elected were: chairman, S. R. Knapp, Connecticut Light & Power Co.; vice-chairman, William C. Pierce, Eastern Shore Public Service Co., and directors, W. L. Ellis, Public Service Electric & Gas, Newark; L. F. Mayer, New York Power & Light Corp.; G. R. Perry, Metropolitan Edison Co.; E. A. Steinbuhler, Consolidated Edison Co.; and M. I. Allen, Philadelphia Electric Co.

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International Groups Hold Meetings to Plan Work

Two international power organizations met this month.

The Council of the Conference Internationale des Grands Reseaux Electriques a Haute Tension met from November 14 to 16 in Paris to revise statutes and to arrange for the resumption of biennial sessions beginning in 1946. This organization concerns itself primarily with high voltage electrical transmission and related matters.

At the council meetings, the United States National Committtee was represented by C. A. Powel, now located in Berlin, with the association of Col. Walker Cisler and members of his staff as technical advisers. In civilian life Mr. Powel is associated with Westinghouse Electric Corp., and Col. Cisler with Detroit Edison Co.

The International Executive Council of the World Power Conference was held November 20 and 21, in London. Resumption of activities of the World Power Conference, which held its last plenary session in Washington in 1936, was planned. Mr. Powel represented the United States Executive Committee at this meeting.

Chairman of the United States National Committee of the World Power Conference is Gano Dunn, president of the J. G. White Engineering Corp., and John C. Parker, consultant for Consolidated Edison Co., is secretary.

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Texas Court Now Forbids Payments in Lieu of Taxes

A river authority created by the Texas Legislature cannot make payments in lieu of taxes to government subdivisions, the State Supreme Court has held in a reversal of its earlier opinion (ELECTRICAL WORLD, July 28, Page 4).

The test case was between Lower Colorado River Authority, which generates and sells electricity to 250,000 persons in Central Texas, and the Chemical Bank & Trust Co. of New York, as trustee for bondholders.

The authority was seeking to determine whether it could make payments in lieu of taxes upon property which it removed from the rolls of school districts and other taxing units. The bank contended the legislative act granting this permission was unconstitutional. The latter view was upheld by the trial and civil appeals courts, but set aside last July by the Supreme Court, then composed of three members.

At an election in August, the voters elevated to membership on the court six men who had been its advisory commissioners. All six sided against the old court and affirmed the lower court's decision that the act was unconstitutional. Public property cannot be taxed in Texas, and Associate Justice Few Brewster wrote in his majority opinion that the fact that the property produces revenue from sale of electricity does not change its tax-exempt status.

Writing the dissent, Chief Justice James P. Alexander said the Constitution does not specifically cover such agencies as river authorities and that the framers did not intend to exempt from taxation such industrial enterprises as Lower Colorado River Authority.

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5 Towns Get Service

Five additional Idaho and Wyoming towns now are receiving service as a result of completion of a 55-mile, single-phase, 7,200-volt line the last week in October by Utah Power & Light Co. The new line makes electricity available to all communities in Bear Lake County, Idaho.

Arizona Bodies Struggle to Control State's Power

Phoenix Businessmen Attempting to Buy Control of Central Arizona Light & Power Following Divestment by American Power & Light—State Authority Seeks Important Standby Steam Plant of Tucson Utility

Arizona's largest utility came out from under its holding company parent, American Power & Light Co., last week with the sale of 840,000 shares of Central Arizona Light & Power Co. stock to a syndicate of investment bankers headed by the First Boston Corp., New York City, at a competitive sale.

The 29 firms making up the syndicate, including Refsnes, Ely, Beck & Co. of Phoenix, got the shares on a high bid of $12.42 per share. Sales opened at $13.12½ with a block of 125,000 shares pledged to Phoenix businessmen. The local bond houses hoped to run that figure up to 200,000 shares in an effort to establish operating control of the utility in **Arizona.**

Colorado River Power Sought

The move was another effort in the running fight of Arizona business interests with the Arizona Power Authority, created by the State Legislature last year to bring cheap Colorado River power into the state and make it available at cost to all Arizona communities desiring it.

The fight opened several weeks ago when the Power Authority intervened before the Arizona Corporation Commission in a hearing on a petition by Arizona Edison Co. for permission to purchase Tucson Gas, Electric Light & Power Co. The city of Tucson opposed granting the permit on grounds that Arizona Edison was interfering in its negotiations for the property, which have been in progress since the Securities and Exchange Commission ordered Federal Light & Traction Co. of New York three years ago either to divest itself of its Deming, N. M., properties or the Tucson property. Federal chose to sell the latter.

The Power Authority sided with the city of Tucson, and itself asked permission to buy the Tucson utility standby plant and transmission lines serving other communities, and the Corporation Commission denied Arizona Edison's request.

Arizona Edison came back last week with a request for a rehearing, charging that the commission acted "capriciously and arbitrarily" in denying its application and that the Arizona regulatory body was interfering with the carrying out of the provisions of the Federal Holding Company Act.

However, simultaneously in Philadelphia, SEC was granting a petition of Federal Light & Traction to withdraw its request for approval of the sale to Arizona Edison, whose purchase contract expired October 24.

Meanwhile, the Power Authority, proceeding with its plans, had filed condemnation proceedings against the steam generating plant owned by Central Arizona Light & Power Co. near Phoenix and transmission lines from it serving several small communities.

This steam plant is the hub of the present interconnected state power system, which is dominated by Central Arizona Light & Power Co., the Tucson company, and the Salt River Valley Water Users' Association, an irrigation district which generates power at its dams on Salt River. Consequently, the Power Authority declared it must have this plant to be used for standby purposes if it is to establish an integrated system of power distribution in Arizona.

In answering the Power Authority's condemnation suit, Central Arizona Light & Power Co. challenged its constitutionality and its powers under the Power Authority Act to condemn property.

Then the Power Authority topped off last week's developments by asking the Arizona Corporation Commission to let it intervene in opposition to granting Arizona Edison a rehearing on its efforts to buy the Tucson property.

It appeared time out will be called in the battle over control of the state's power distribution facilities while a legal fray is engaged in to determine if the Power Authority has been given sufficient legal power to carry out its program.

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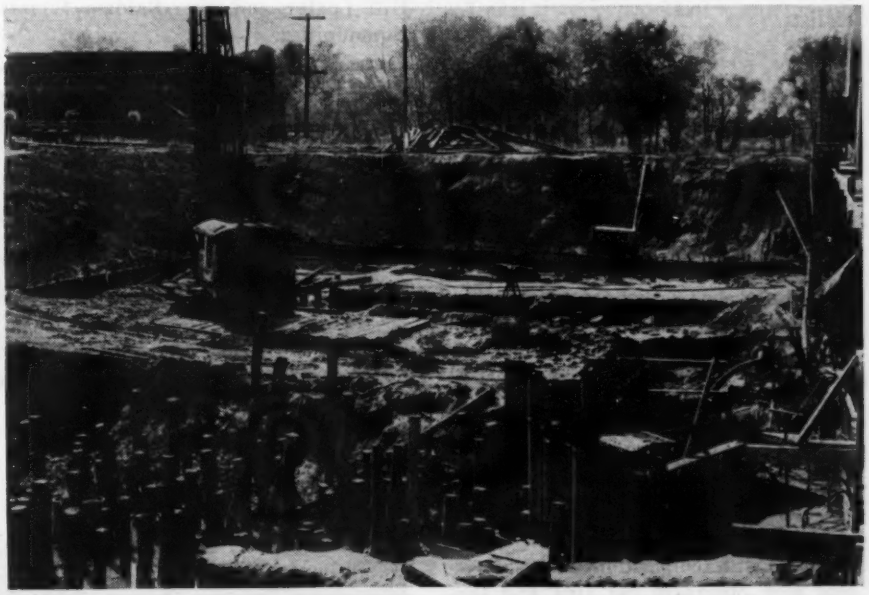
61 Applications on Record for Central Valley Power

Disclosing that the Bureau of Reclamation has had 61 applications for California's Central Valley Project power, Richard L. Boke, newly appointed regional director, on taking office pledged himself to the immediate objective of getting cheaper power for the people of the Sacramento and San Joaquin Valleys. Most of the requests were from public agencies, he said.

He pointed out that the Bureau's request to Congress for $35,000,000 for reconstruction during the remaining part of the present fiscal year included funds for power transmission lines from Shasta Dam to Central Valley users. One of the lines, he said, would deliver electricity to Roseville, first California municipality to sign a contract for Shasta power.



EXCAVATION PROGRESSES—On this site at the Harding Street plant of Indianapolis Power & Light Co., an addition will be built to house another 37,500-kw. turbo-generator and 400,000-lb. per hr. boiler. Ground was broken July 16, and equipment is scheduled for operation October 1, 1946. Total cost will be $3,600,000

Sound Transformed into Visible Pattern

Sound, whether it be speech, music or noise, can be transformed into patterns on a screen for ready interpretation by the eye. Apparatus for this purpose was developed and recently demonstrated at Bell Telephone Laboratories, New York.

Since each spoken sound and word has its own pattern, practice will eventually equip the deaf person with a vocabulary of patterns as extensive as he is willing to acquire. The demonstrator, a deaf man who has been working ten months with "visible speech," has greatly improved his ability to talk and also to add emotional color to his speech. It is thought that this method may ultimately be used for speech improvement and correction, and to teach pronunciation of foreign language. In addition it can be an aid in the study of the noise of industrial machines.

Two types of instruments are used: One, the "spectograph," has a loop of magnetic tape on which sound is recorded and by means of which it can be studied in detail; the other is a "translator" which has several filters, glow lamps, and an endless belt coated with phosphorescent material on which the patterns of speech appear. The patterns, passing out of sight, are erased by infra-red lights.

No devices are available to be put on the market, according to Dr. O. E. Buckley, president of Bell Telephone Laboratories. However, Ralph K. Potter, research engineer, explained that they hoped to develop an instrument which could be used by educators and specialists.

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200,000-Kva. BPA Station Will Better Transmission

Moving to eliminate serious transmission bottlenecks of the Bonneville Power Administration in the Puget Sound area of Washington, Dr. Paul J. Raver, administrator, has called for bids on four 50,000-kva. power transformers for a proposed substation at Snohomish.

Construction of the station is scheduled to start early next year and will become one of the major distribution centers of the Bonneville-Grand Coulee transmission network.

Bonneville engineers said the new station would provide a sorely needed point of interconnections of the system with others in the area and that, as the western terminus of 230,000-volt lines to be constructed from Grand Coulee and the proposed Foster Creek station, will make power available to Everett through the Snohomish County P.U.D.

Three of the transformers will be installed in a single bank with a self-cooled capacity of 150,000 kva. and a top capacity of 250,000 kva. under forced-cooled operations. The fourth transformer will be used as a spare.

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Consultant Calls Denver Ideal Center for Poles

Denver, Colo., is the ideal center for processing and shipping a major portion of the poles needed for 1,500,000 miles of new Rural Electrification Administration electric lines, according to Evan W. Kelley, R.E.A. special consultant, touring the country in an effort to increase poles production above the pre-war average.

Large stands of lodgepole pine in the Rocky Mountain area that are in easy shipping distance to the consumer area make Denver the logical location, it was reported. According to Mr. Kelley, new line construction will necessitate 3,000,000 poles annually, and there is a present shortage of 1,500,000 million poles.

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Line Will Serve Utility

Construction has begun on a 44,000-volt line to supply the Riviera Utilities Co. at Foley, Ala., from a substation on Blakely Island across the Mobile River from Mobile, Vice-President A. D. Quackenbush of the Alabama Power Co. has announced. Riviera Utilities serves Foley, Silver Hill, Loxley, and other Baldwin County communities.

Kentucky Wants Tax Cut to Go to Users

Believing that the excess profit taxes which Kentucky utilities have been paying to the Federal government should now go to the people in the form of reduced rates, the Kentucky Public Service Commission has ordered 22 utilities in the state to show cause by December 4 why their rates should not be reduced in an amount equal to their savings on such taxes.

All of the leading electric utilities are included in the order, including Louisville Gas & Electric Co., Kentucky Utilities Co., Kentucky & West Virginia Power Co., Union Light, Heat & Power Co., Community Public Service Co., and Kentucky Electric Power Corp.

Each company cited must report by December 4 the amount of excess profits taxes paid the Federal government in 1944, under its last Federal tax report, together with the amount now accrued, if any, on which the tax is due, and any refunds or credits to which it may be entitled as the result of former payments.

In addition each company must show cause why a reduction in rates, in the form of revised schedules, rate reductions, or refunds, shall not be filed with the commission by reason of the repeal of the excess profit tax law.

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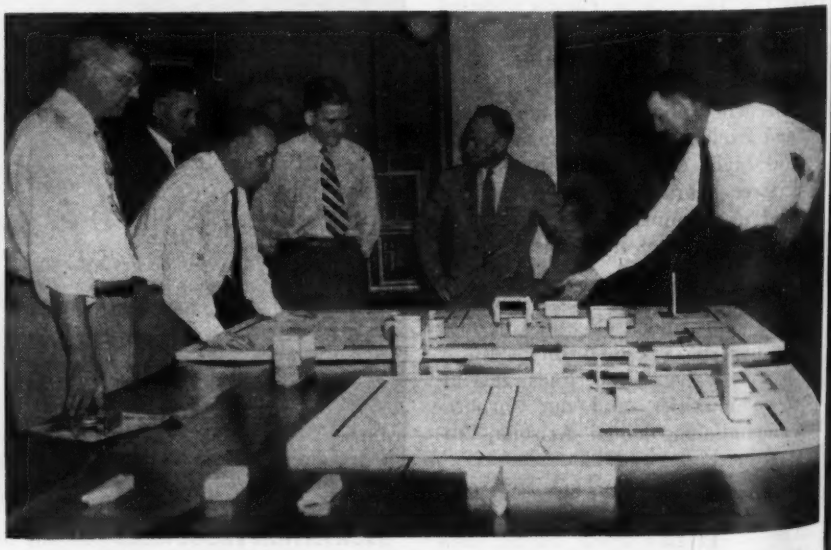
Appointed to Authority

W. D. Corder has been appointed to the board of directors of Lower Colorado River Authority by Gov. Coke Stevenson of Texas to fill the unexpired term of Thomas C. Ferguson who resigned.



THEY OUGHT TO LOOK THIS WAY—C. A. Collier, in center wearing coat, vice-president and sales manager of Georgia Power Co., confers with his assistants on plans for company stores. All are to be modernized as soon as possible

Utility Will Cooperate with Nearby Co-ops

Oklahoma Gas & Electric Tells Wickard of Program of Cooperation to Develop Rural Territory

Oklahoma Gas & Electric Co. has informed Claude Wickard, Rural Electrification Administrator, that it has adopted the following policy of cooperation with rural electrification cooperatives:

"The company will continue to be a good neighbor. We will not 'skim the cream' by building into densely populated farm areas not adjacent to communities being served by us. We will not build duplicating or 'spite' lines. We will confine our rural construction to branch extensions from existing lines and will build new lines only into areas defined as ours by agreement between the farm electric cooperatives and ourselves. We believe by working together, the cooperatives' management and our own staffs can satisfactorily define territories and allocate customers. This, we are confident, can be accomplished by:

The preparation of maps of unserved areas wherein potential customers reside. By agreement, the limits of service should be clearly recorded in these maps so that the cooperatives and ourselves will know definitely who is to render service to a specific area. The cooperative and the company both should have identical copies of these maps and they should be kept current so that agreed-on revisions can be readily recorded.

Regular Rates to Prevail

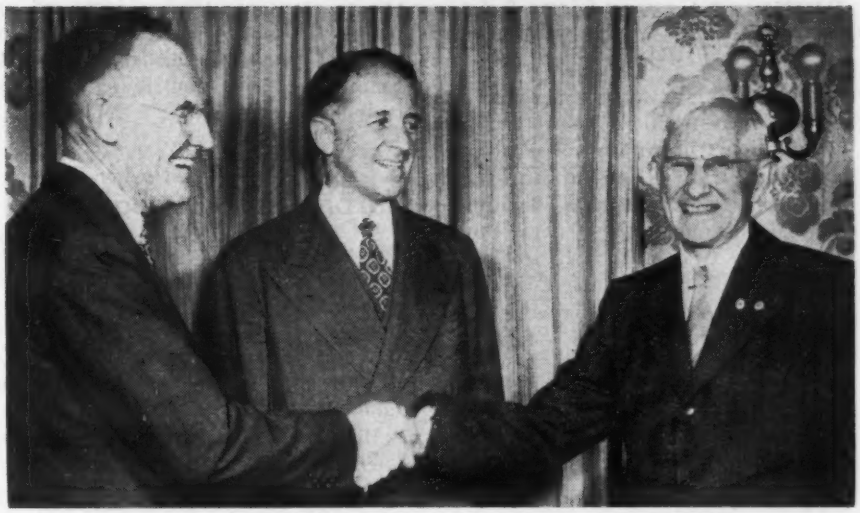
The company will serve all applicants residing within its assigned area, when the need for service arises, in accordance with published rate schedules.

The company will not solicit customers residing in cooperatives' assigned areas nor in areas unassigned until after mutual agreement has been reached.

The company will relinquish to the cooperatives prospective customers within areas which may have been designated for company development if service to such customers can be rendered by the cooperatives with greater economy of time and material.

The company will keep the cooperatives informed of intended major extensions and any changes in rural electric rates and extension practices.

The company will, whenever possible, assist the cooperatives in the development of new business and will, whenever feasible, coordinate sales, advertising and demonstration programs with those of the cooperatives."



GOLDEN ANNIVERSARY—Jesse Reed, right, is congratulated by President W. C. Bell on completing 50 years with the United Illuminating Co. Mr. Reed has headed the meter department since 1901. Vice-President C. A. Williams is third person

FPC Arizona Rate Study Foes Seek Referendum

Referendum petitions were placed in circulation last week in all Arizona counties against a bill enacted by a recent legislative session (ELECTRICAL WORLD, October 27, Page 157) that appropriates $50,000 to the Arizona Corporation Commission for employment of Federal Power Commission experts to survey state utility rates.

The bill, sought for several years by Gov. Sidney P. Osborn and bitterly fought by utilities, finally was pushed through the recent special legislative session on the last day when law makers learned the Governor planned to call them back for another session the next day unless they passed it.

The measure is regarded as vital by the Corporation Commission, which has only one $200 per month employee in its utility division to regulate utilities all over the state. Other states of comparable size have a staff of about 20 rate experts, it is pointed out. Arizona utilities have not had their rates studied by the Corporation Commission for ten years.

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Huls Succeeds Sachse

Appointment of Harold P. Huls to the California Railroad Commission has been announced by Governor Earl Warren. Mr. Huls, city attorney of Pasadena for the past 17 years, succeeds Richard Sachse, who resigned to accept an appointment to the Federal Power Commission.

For a number of years Mr. Huls has been chairman of the franchise committee of the League of California Cities, where he specialized in working out problems arising from jurisdictional disputes between city and state public utility control groups. He is the co-author of a book titled "Modern Building Inspection."

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Salem, Ore., Co-op Again Loses Chance to Expand

Salem Electric Cooperative again has been blocked in its efforts to expand service in Salem, Ore., which is now limited to a few downtown customers.

A move by the cooperative to purchase abandoned poles owned by Oregon Electric Railroad Co., which formerly operated an electric railway through Salem, failed when Portland General Electric Co., which serves Salem, beat the co-op to the gun.

The co-op disclosed its plan November 5 when it applied to the Salem city council for permission to buy the poles. The council tabled the application for two weeks, and in the meantime the Portland company purchased two 16-mi. sections of the Oregon Electric Railroad's transmission lines, with the announced purpose of providing an alternate power line to Salem.

Numerous attempts have been made by the co-op to extend its Salem service in spite of the results of two elections in which voters of the city rejected its application for a franchise.

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Will Extend Service

Cincinnati Gas & Electric Co. which now serves Madeira, Ohio, will extend its service shortly to the Osceola Park district which was annexed by Madeira two years ago. The utility has been granted a franchise by city council.

Alabama Power May Add to Original Cost of Dam

The Federal Power Commission, acting under instructions from the Fifth Circuit Court of Appeals, has allowed addition of $118,481 to the $15,209,611 previously determined as legitimate original cost under the Federal Power Act for the Martin Dam hydroelectric development of Alabama Power Co. The company claimed original cost of $17,561,280 and took FPC's first finding in the case to court.

The additional amount which the company is now authorized to add to plant account consists of four items: $44,606 representing traveling expenses, bonuses or additional compensation and special payments to employees; $70,000 as a cost of the right to flood lands; $2,100 representing three percent general administrative expenses on the $70,000, and $1,775 allowance for interest on the additional amounts which were expended during the interest period.

FPC's amended order directs Alabama Power to charge $2,161,301 of the disallowance of claimed cost to earned surplus and the remainder to various other asset accounts. The project originally was licensed in 1923 and was completed in 1927.

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Pension Fund Established

All employees of the Portland General Electric Co. are covered by a retirement plan approved recently by the board of directors. Under the plan, which is in addition to social security, employees will draw retirement salaries based on their years of service and salaries. Maximum will be $87.50 monthly, and retirement age, 65. A special insurance trust is being set up by contributions from the company covering about two-thirds of the cost. Employees will contribute the remainder.

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Surplus Property Sales

Surplus property sales up to September 30 as announced by the Reconstruction Finance Corporation included:

Generator-set units—total cost, $12,102,000; total sales, $1,073,000; on hand, $9,311,000, cost price.

Motors—cost, $1,472,000; sales, $469,000; on hand, $674,000.

Transformers — cost, $1,332,000; sales, $443,000; on hand, $716,000.

Other electrical machinery and equipment—cost, $7,246,000; sales, $653,000; on hand, $5,851,000.

Rubber-insulated copper wire—cost, $2,094,000; sales, $240,000; on hand, $1,643,000.

Other insulated wire and cable but not for communications—cost, $880,000; sales, $11,000; on hand, $861,000.

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Quits Power Authority

H. C. Schwalen has resigned his position on the Arizona Power Authority, according to a recent announcement by Gov. S. P. Osborn.

Mr. Schwalen is head of the agricultural engineering department at the University of Arizona and was barred from receiving compensation for his services on the authority.

With two vacancies on the five-man authority, Governor Osborn said he intends to make both appointments in the near future.

DALLAS IS PREFERRED—This show window of the Dallas Power & Light Co. informs passers-by that industry prefers Dallas for a market center, skilled workers, and cheap electricity. A similar window display said that people prefer Dallas for friendliness, progressiveness, and cheap electricity

MEETINGS

Previously Listed

American Society of Mechanical Engineers—Annual meeting, Hotel Pennsylvania, New York, N. Y., week of November 25. Ernest Hartford, executive assistant secretary, 29 W. 39th St., New York 18, N. Y.

National Association of Railroad and Utilities Commissioners — National meeting, Deauville Hotel, Miami Beach, Fla., December 4-7. Ben Smart, secretary, 7411 New Post Office Bldg., Washington, D. C.

Southeastern Electric Exchange—Commercial Section, Atlanta Biltmore Hotel, Atlanta, Ga., December 5-7. J. W. Talley, executive secretary, 303 Haas-Howell Bldg., Atlanta, Ga.

Pacific Coast Electrical Association—Joint meeting of Business Development and Operating Economic sections, Hotel Californian, Fresno, Calif., December 7-8. V. W. Hartley, managing director, 601 W. 5th St., Los Angeles 13, Calif.

American Institute of Electrical Engineers—Winter convention, New York, N. Y., January 21-25, 1946. H. H. Henline, secretary, 33 W. 39th St., New York 18, N. Y.

Institute of Radio Engineers — Winter technical meeting, Astor Hotel, New York, N. Y., January 23-26, 1946. Haraden Pratt, secretary, 330 W. 42nd St., New York 18, N. Y.

Feather Falls, Calif., Will Get Shasta Dam Power

Shasta Dam power is assured Feather Falls, Calif., by the Rural Electrification Administration's approval of a $110,000 loan for the construction of a power line and distribution system. Vernon B. Chamberlen, president of the Feather Falls Electric Cooperative, announced the signing of the contract that provides for repayment in 35 years with 5 years grace before the first payment is due. The loan has a 2 percent interest rate.

The new line will run from Oroville, southern terminus of the Bureau of Reclamation's only California transmission system, to Feather Falls, a distance of about 30 miles.

The Shasta power will replace electricity now generated by a small power plant burning sawdust and waste lumber for fuel. Three hundred families in the Feather Falls area will be served when the new system is completed.

•

Tax Refund Appealed

An appeal has been made to the Arkansas Supreme Court by Revenue Commissioner Otis A. Cook from a decree of the Pulaski Chancery Court which directed him to refund to Arkansas Missouri Power Corp. delinquent income taxes for the years 1937-40 totaling $3,337.98.

The utility claimed in the lower court that the commissioner had collected taxes on dividends of certain shares of East Missouri Power Co., owned by it, in proportion to Arkansas Missouri's gross Arkansas revenues.

Montana-Dakota Co. Buys Dakota Public Service Co.

Montana-Dakota Utilities Co. has purchased the Dakota Public Service Co. and the Knife River Coal Mining Co. Dakota Public Service provides electric service in 91 communities in western North Dakota and South Dakota and steam heat in five communities. The coal mining company has a mine at Bulah, N. D., and sells coal on the market in addition to supplying Dakota Public Service.

Montana-Dakota Utilities has a contract with the government for power from Fort Peck Dam and plans to build a transmission line from Glendive, Mont., where this power is received, to Dickinson, N. D. Another line is planned from Baker, Mont., to Lemmon, S. D.

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Court Denies New Trial to Portland, Ore., Utility

Motion for a new trial presented by the Portland General Electric Co., respondent in condemnation proceedings brought by Clark County, Wash., Public Utilities District No. 1, has been denied by Judge Ben Harrison in Federal District Court at Tacoma. A jury fixed $801,000 as a fair market value for the company's properties in and near Vancouver, Wash., which the district seeks to acquire. Attorneys for the company announced that an appeal will be taken to the United States Circuit Court.

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Condemnation Suit Begun by Cowlitz County P.U.D.

Condemnation proceedings have been filed at Kelso, Wash., by the Cowlitz County Public Utilities District against the Northwestern Electric Co., which serves the Kalama and Woodland, Wash., areas, and the Pacific Power & Light Co., operator of the Aerial dam on the Lewis River. The complaint disclosed that the P.U.D. commissioners had adopted a resolution proposing to take over the power company holdings at a price not to exceed $300,000.

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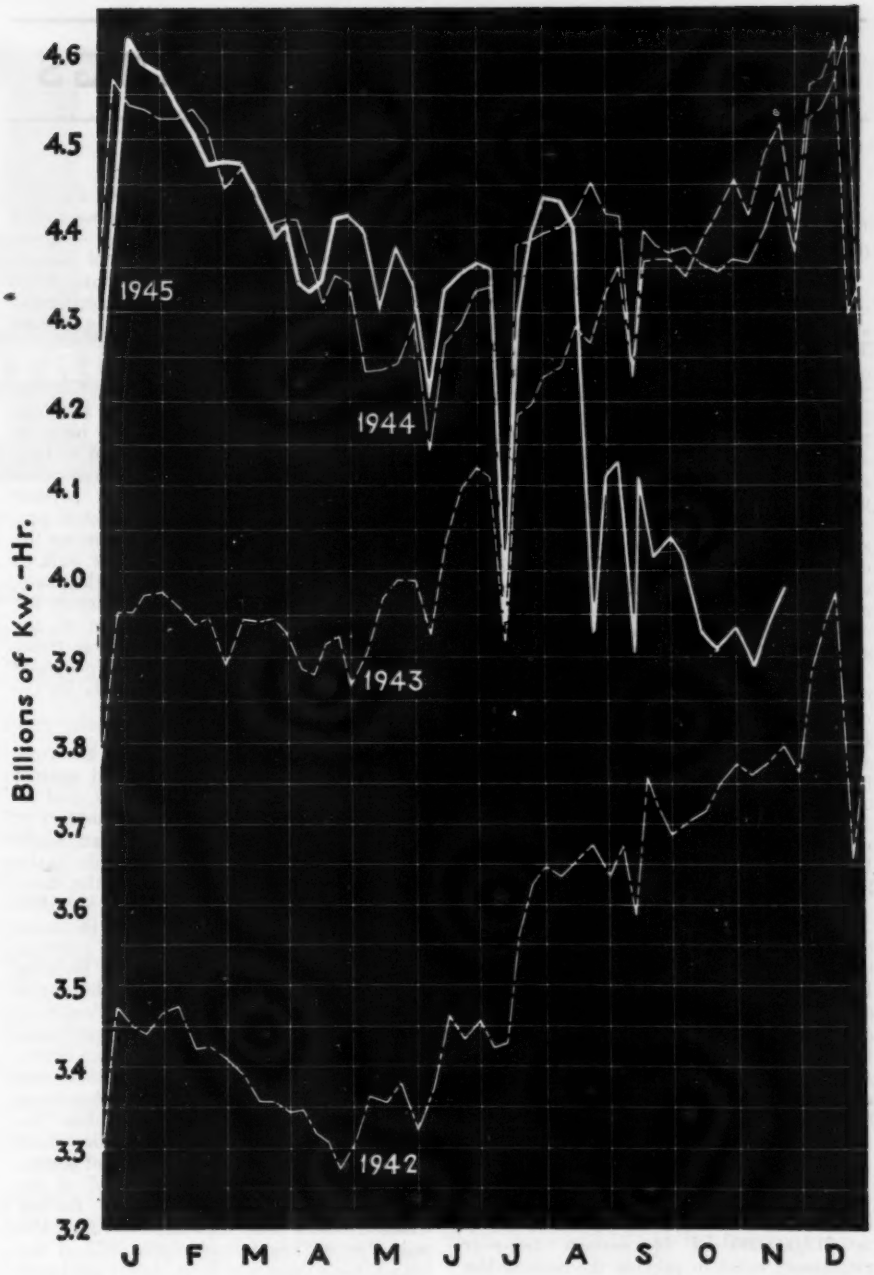
Will Buy Norris System

Clinton, Tenn., City Council has authorized the municipal power commission to buy the Norris rural electric distribution system from Tennessee Valley Authority. The commission is empowered to issue $250,000 in bonds for refunding and purchase of the 800-user system.



Output Curve Again Moves Upward

The electric output curve moved upward again during the week ended November 17, 1945, according to figures released by the Edison Electric Institute. The amount of electrical energy distributed by the light and power industry totaled 3,984,608,000 kw.-hr., compared with 3,948,024,000 kw.-hr. during the preceding week. During the week ended November 18, 1944, the amount of electrical energy distributed amounted to 4,450,047,000 kw.-hr., this year's figure representing a decrease of 10.5 percent.

All of the major geographical regions of the country reported losses for the week ended November 17, as compared with the corresponding week last year, according to the E.E.I. report.

Weekly Output Millions Kw.-Hr.

1945		1944		1943	
Nov. 17	3,985	Nov. 18	4,450	Nov. 20	4,513
Nov. 10	3,948	Nov. 11	4,397	Nov. 13	4,483
Nov. 3	3,899	Nov. 4	4,355	Nov. 6	4,414
Oct. 27	3,937	Oct. 28	4,358	Oct. 30	4,453
Oct. 20	3,915	Oct. 21	4,345	Oct. 23	4,415
Oct. 13	3,934	Oct. 14	4,355	Oct. 16	4,382
Oct. 6	4,028	Oct. 7	4,375	Oct. 9	4,342
Sept. 29	4,039	Sept. 30	4,366	Oct. 2	4,359
Sept. 22	4,019	Sept. 23	4,377	Sept. 25	4,360
Sept. 15	4,106	Sept. 16	4,395	Sept. 18	4,359
Sept. 8	3,909	Sept. 9	4,228	Sept. 11	4,229
Sept. 1	4,137	Sept. 2	4,415	Sept. 4	4,351

Percent Change from Previous Year

	Week Ending		
	Nov. 17	Nov. 10	Nov. 3
New England	— 6.4	— 4.9	— 4.9
Mid Atlantic	— 4.4	— 4.8	— 4.2
Central Industrial	— 12.3	— 12.3	— 11.8
West Central	— 1.8	— 1.6	— 1.0
Southern States	— 14.8	— 14.2	— 16.3
Rocky Mountain	— 0.5	— 0.8	+ 0.6
Pacific Coast	— 12.3	— 11.2	— 12.1
Total United States	— 10.5	— 10.2	— 10.5

SEC DECISIONS—HEARINGS

The Securities and Exchange Commission recently issued a series of orders affecting electric utility companies.

UTAH POWER & LIGHT CO.'s plan to recapitalize with a single class of common stock has been approved by the commission. The plan, which has as its stated purpose compliance with an SEC directive of Nov. 29, 1943, was filed jointly by Utah and its parent, Electric Power & Light Corp. It provides for Utah's issuance of 1,185,241 one-quarter shares of new no par value common stock with a stated value of $20 per share. Utah will exchange all the new securities for its outstanding preferred stock on the basis of 4¼ shares of new common for each share of $7 preferred and 4⅜ shares of new common for each share of $6 preferred. The preferred will then be cancelled. The plan also provides for Utah to acquire and cancel the 3,000,000 shares of common and 2,100 shares of $7 preferred now held by Electric Power & Light. In return for these securities, Utah will pay Electric $650,000; will assign to Electric any claims against the latter's parent, Electric Bond & Share Co., and its wholly owned subsidiaries, which Utah or its subsidiaries may have against them, and will release Electric from any claims which Utah or its subsidiaries may have against Electric.

INTERNATIONAL HYDRO-ELECTRIC SYSTEM trustee, Bartholomew A. Brickley of Boston, has been granted permission to apply to a United States District Court for interim compensation of $16,666 for services rendered in a period ended on July 15. Mr. Brickley also was permitted to ask $2,083 a month as interim compensation for future services, plus reimbursement of future disbursement not to exceed $100 a month.

Applications Filed

AMERICAN WATER WORKS & ELECTRIC CO., INC., has filed an application to issue up to $12,000,000 of 1¾ percent two-year promissory notes to provide the bulk of the funds necessary to retire $11,000,000 of 5 percent and 6 percent debentures and the $2,500,000 of 2 percent notes now outstanding. This constitutes the company's entire present debt. The proposed retirement is being undertaken in order to secure certain tax advantages and as a preliminary step to filing with the SEC a revised reorganization plan to satisfy requirements of the utility holding company act. The management expects to be able soon to file a revised plan which can be carried out under present conditions and which will preserve and protect the interests of security holders.

SIOUX CITY (IOWA) GAS & ELECTRIC CO. has registered with the commission $8,000,000 of first mortgage and collateral trust bonds, due 1975; 38,000 shares of $100 par value cumulative preferred stock, and 153,006 shares of $12.50 par value common stock. The bonds and stocks will be sold through competitive bidding, with the stock subject to prior rights of stockholders. The company proposes to offer holders of its outstanding 47,954 shares of old preferred the right to exchange them for new preferred on a share-for-share basis. Shares not exchanged will be redeemed at $110 a share. The offer expires December 24. The company is offering through subscription warrants 101,904 shares of the common stock to commonstock holders of record December 10, on a share-for-share basis until December 24. Of the common stock, 34,068 shares are owned by Iowa Public Service Co., a subsidiary.

CONSOLIDATED ELECTRIC & GAS CO. has applied for permission to borrow $14,000,000 from banks on a short term basis at 2¾ percent. The funds will be used to help retire the company's slightly more than $14,000,000 of collateral trust 6 percent bonds of 1957 and 1962. Consolidated proposes to pay the 3 percent premium on the 1962 maturity, which comprises the bulk of the debt outstanding. Including this sum, the cost of the redemption will slightly exceed $15,000,000 and the balance of the amount necessary will be drawn from treasury resources. Collateral for the proposed bank loan will be the same as exists for the bonds.

NORTH AMERICAN CO. has asked the commission to dismiss claims asserted against the company by Illinois Power Co. and by a committee representing certain holders of preferred stock of North American Light & Power Co. The demand was made in the top-holding company's answers to the statements of claim, in which it denied virtually all of the allegations contained in them. North American declared that the commission has no jurisdiction under the Holding Company Act, or otherwise, to determine the claims asserted by Illinois Power or North American Light & Power preferred stockholders; that the Illinois Power claims are barred by the statute of limitations and that the claims asserted by North American Light & Power preferred-stock holders "relate to transactions occurring many years ago and are barred by the statute of limitations and by the laches and delay" of the complaining stockholders. As a further defense North American declared that Illinois Power "has known since 1927 of the transactions upon which its claims are based and has refrained from asserting such claims.

OHIO PUBLIC SERVICE CO. AND OHIO RIVER POWER, INC., subsidiaries of Cities Service Co., have filed a proposal for Ohio River to issue and Public Service to acquire at par $2,000,000 of the former's $100 par value common stock before May 1, 1946. Ohio River thus would acquire funds for construction of an additional generating unit in its R. E. Burger plant at Dilles Bottom, Ohio. The total cost would be about $5,000,000.

WEST TEXAS UTILITIES CO., CENTRAL POWER & LIGHT CO. and CENTRAL AND SOUTHWEST UTILITIES CO., all subsidiaries of the Middle West Corp., has asked the SEC to approve West Texas' proposal to buy for $815,000 the electric utility and ice properties of Central Power in the Texas counties of Brewster, Ford Davis, Reeves and Presido. The transactions, the applicants said, would bring about compliance with an order of the SEC of Jan. 24, 1944.

Hearings Scheduled

NOVEMBER 30: On American Power & Light Co.'s amended plan for the retirement of its outstanding 6 percent gold debentures, due 2016, and the 6 percent gold debenture bonds of Southwestern Power & Light Co. assumed by American, both at 110 percent of principal amount, plus accrued interest.

DECEMBER 3: On proposal of American Power & Light Co. to sell its holdings of stock and other interests in New Mexico Electric Co. at private sale to M. J. Murray Jr., of Hobbs, N. M., for $1,206,000 in cash, plus $150 a day from Sept. 30, 1945, to the closing date.

UTILITY REPORTS

	Net Income 1945	1944
*Central Illinois Public Service	$2,061,512	$2,017,349
*Columbia Gas & Electric and subs	12,508,014	14,186,903
*El Paso Electric	644,406	624,286
*Gulf States Utilities	2,528,476	2,227,650
*Iowa-Illinois Gas & Elec.	2,568,176	2,368,589
*Iowa Southern Utilities	319,360	234,513
*Niagara Hudson Power and subs	7,496,391	6,496,477
*North American and subs.	14,177,300	16,428,699
*Pacific Power & Light	639,997	748,200
*Virginia Electric & Power	6,648,738	5,119,965

*Twelve months ended September 30.

Better Sight Bureau Film Now Available to Utilities

Taking as its theme, "Why the home needs better lighting," a new sound-slide film, "See for Yourself," has been released by the National Better Light Better Sight Bureau, 420 Lexington Ave., New York 17, N. Y.

The new production, which has been called authoritative and entertaining by lighting authorities, will be useful to home lighting departments of utilities which desire to bring the importance of good home lighting to groups such as parent-teachers associations, civic clubs, and older school children.

Abandons Rail Line

Ohio Public Service Co. has abandoned 35 miles of electric interurban track which was part of a line from Toledo to Sandusky Bay. The 11-mile line remaining from Toledo to Clay Center will be limited to freight service. In recent years, most of the freight hauled on the line was coal for Toledo Edison Co.'s Acme plant.

Utility to Extend Service

Chama Light & Power Co. has been authorized by the New Mexico Public Service Commission to extend its service to customers in Park View, Tierra Amarilla, Ensenada, Brazos, and La Puente.

HOW

DESIGN · CONSTRUCT · OPERATE · MAINTAIN

Hang Three-Phase Transformers From Poles

NED CRIDER
Distribution Engineer
Union Electric Co. of Missouri, Webster Groves, Mo.

For capacities of 150 kva. and less, Union Electric Co. of Missouri uses a three-phase 4,160-volt transformer supported by a hanger and short crossarm in preference to a bank of three single-phase transformers. Loads of 150 to 300 kva. are frequently supplied by paralleling two 100 to 150-kva. three-phase transformers, each individually mounted.

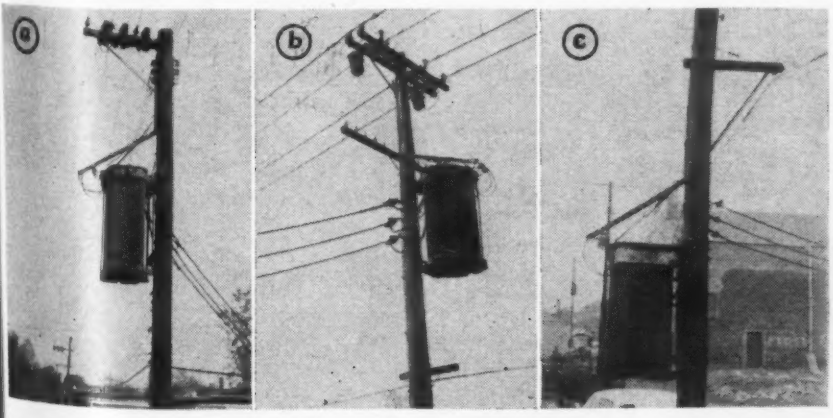
Such installations can be made at a lower cost than banks of three single-phase transformers and better clearances can be secured. Moreover, there are many locations, close to buildings, where platform construction cannot be used.

Accompanying illustrations show the method most commonly used to mount these transformers with accessories. Fuses and lightning arresters are installed on the line arm and three single-conductor, oil-base insulated 4,160-volt conductors are carried in fiber conduit strapped to the pole. This conduit is extended at a 45-deg. angle over the top of the case to the primary bushings. Although secondary conductors can usually be attached near the secondary bushings, if a higher elevation is required they are sometimes carried up the pole in fiber conduit.

The mounting consists of 3¼-in. by 4¼-in. oak arms 3 ft. 6 in. long with a 10-in. block mounted directly under it for additional support, and a 2 ft. "kicker" arm. The top arm is supported by four 1¼-in by ¼-in. metal braces 24 in. long; two above and two below. In the case of 75-kva. and larger transformers, strain on the machine bolt supporting the arm is relieved by an eye attached to the pole about two feet above the transformer, from which a turn buckle is connected to the junction of two metal straps that pass over the front of the case to the bottom.

Transformers can be mounted by this method either above or below communication circuits. If below, however, the telephone company usually requires that the case be grounded. The accompanying three pictures show alley arm construction with a 100-kva. transformer above telephone cable and duplex; a 150-kva. above the telephone and below fire and police circuits and a close-up of a 150-kva. below a telephone circuit.

The company has recently adopted wood braces as standard for 2,400/4,160-volt construction; consequently a new design is being developed substituting wood braces for metal braces. Consideration is also being given to use of a longer supporting arm, permitting the use of only two braces instead of four. Braces above the arm would be eliminated. Also, it may be possible to dispense with the turnbuckle arrangement and substitute a reinforcing metal strap bolted to the pole above the crossarm and attached to the machine bolts supporting the crossarm and the 10-in. block underneath.



THREE-PHASE TRANSFORMER mounting arrangements above illustrate (a) alley arm construction with a 100-kva. unit above telephone cable and duplex; (b) a 150-kva. transformer above telephone and below fire and police circuits and (c) a close-up of a 150-kva. unit below a telephone cable, transformer case usually grounded

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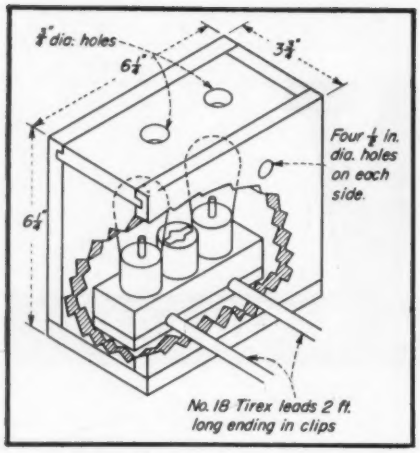
Test Block Safeguards Lamp

In checking a meter installation a service man using a 110-volt lamp accidentally brought its terminals into contact with a 220-volt circuit. The Liberty Mutual Insurance Co., Boston, Mass., reports that in this



PERSPECTIVE of test block and inclosing box to prevent eye injuries in case of destruction of lamp from overvoltage

case the test lamp exploded, causing pieces of glass to enter the test man's right eye, with such severe injuries that later the eye had to be removed.

The company points out that it has been widespread practice to use 220-volt lamps for testing purposes, even though some danger arises in the event of checking 440-volt circuits. Service men like the test lamp because it gives them some indication of voltage conditions, provides light and sufficient load on a meter to enable its rotation to be checked.

To increase the safety of this testing, one service man designed the test block illustrated. It is mounted on the bottom of a plywood box 1/2 in. thick, and is provided with No. 18 Tirex terminals 2 ft. long ending in clips to facilitate contacts in rapid work in the field. Openings 3/4 in. and 1/2 in. in diameter at various locations in the box walls enable the lamp performance to be readily observed, and the outside dimensions of this light box are only 6¼ in. by 6¼ in. by 3¾ in.

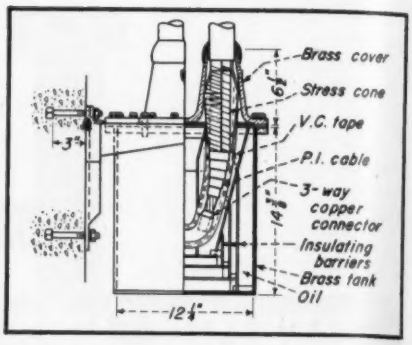


FIG. 2—Cross-section of single conductor Y-type cable joint, wall mounted

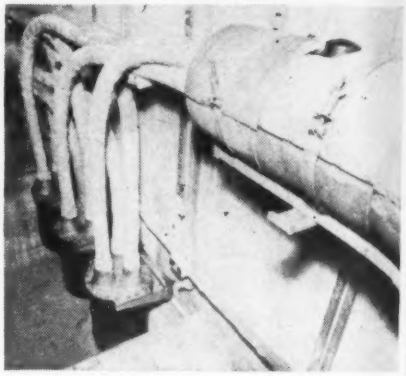


FIG. 3—Typical manhole installation of "T" tap in 34.5-kv. oil-filled cables

• • •

Oil-Filled Cable "T" Tap Saves Investment

BORIS A. GRAY

Electrical Engineer, Los Angeles Dept. of Water & Power

Use of a "T" tap in several lines of 34.5-kv., oil-filled cable is saving the Los Angeles Department of Water & Power considerable investment and brings about a better utilization of existing cable facilities. The method of making such a "T" tap in 34.5-kv., type H, oil-filled, lead-covered cables is as follows:

1. Three three-conductor (3/C), 34.5-kv., type H, oil-filled cables are split into three 1/C leads by means of a "trifurcator" consisting of a lead spreader cup wiped to the 3/C cable and lead pipes slipped over individual conductors and wiped to the spreader cup in the case of new installations, or in case of existing cables by means of a cable joint.

2. The 1/C leads, one from each 3/C cable, are connected together by means of three 1/C, Y-type cable joints, mounted on manhole wall as shown in Fig. 1. The construction of the joint is shown in Fig. 2. The single conductors are soldered into a special three-way connector and are insulated with low-loss varnished cambric tape and a series of bakelite tube and disk barriers, inclosed in a brass tank. The trifurcators, 1/C cable leads and cable joints are treated under vacuum and filled with degasified oil.

A typical manhole installation is shown in Fig. 3.

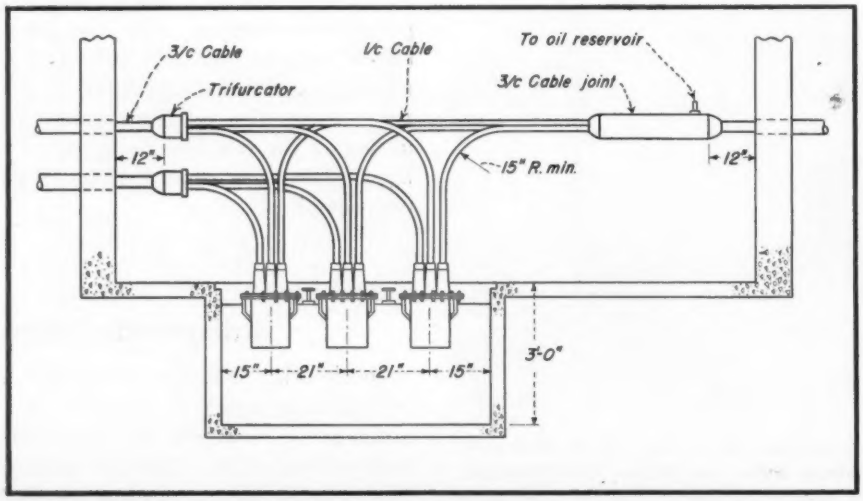


FIG. 1—Single-conductor Y-cable joint installation in manhole

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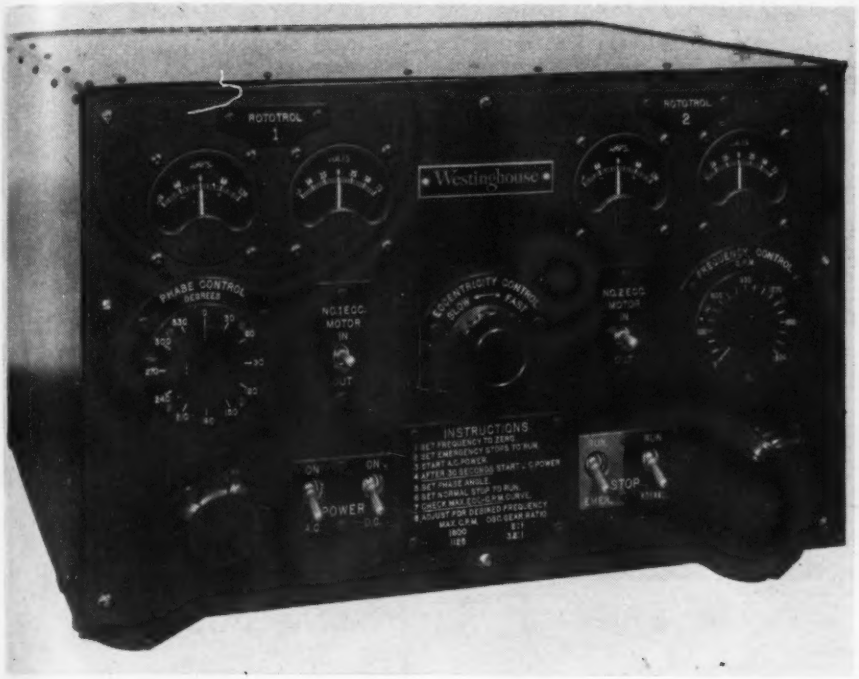
Synchronization of Mechanical Oscillators

Since more than four-fifths of the failures of machines and structures are attributable to dynamic rather than static forces, there is a tendency to put more emphasis on dynamic testing of both specimens and assemblies. A contribution to this art was presented in an ASME war conference on aviation at Los Angeles on June 14, 1945, in a paper by S. W. Herwald and R. W. Gemmell (both Westinghouse) and B. J. Lazan (Sonntag Scientific). The title was "Mechanical Oscillators and their Electrical Synchronization."

Controlled eccentrics give inch-pound forces proportional to eccentric unbalance and to squared angu-



CONTROL UNIT MAINTAINS desired frequency, eccentricity and phase relation of two superposed mechanical vibrations

lar velocity. Oscillators have been built capable of producing alternating forces as high as 44,000 and eccentricity as high as 6,800-in.-lbs.

Accurate control of frequency and force-phase relationship is obtainable for two vibrators through the medium of two Rototrols in a single-case. Desired frequency is maintained within close limits by matching the preset portion of the control unit battery with that of a d.c. tachometer generator. Voltage difference is amplified and the amplified output controls the output voltage of the No. 1 Rototrol generator which in turn changes the speed of the No. 1 oscillator drive motor to restore balance at the desired frequency. The second Rototrol employs a synchro-generator to obtain a predetermined phase relationship between the two oscillations.

•

Transformer Kicker Block

KICKER block merely a 6-in. piece of 4-in. channel iron bolted near bottom of type "T" hanger on California Electric Power system transformers

•

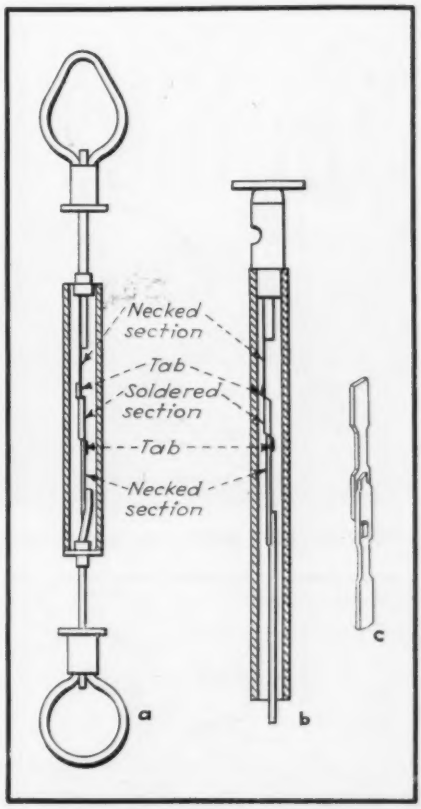
Universal Fuse Links Surge-Proof

Fusible element of a new Hi-surge double-duty fuse link announced by the transformer division of General Electric Co. consists of two identical punchings of a low-melting-point alloy. The two punchings, each consisting of a reduced fusible section and a wider portion, are mechanically interlocked and joined with a solder of the desired melting temperature. At low 60-cycle, short-circuit currents, heat generated in the reduced sections of the fusible element is conducted into the wide portion until the solder melts, permitting the two sections to be pulled apart. At higher, 60-cycle, short-circuit or surge currents, the reduced section melts and severs the link before the heat conducted into the wider section can melt the solder.

Locking construction of the two punchings prevents the ends of the soldered joint from peeling apart under tension, yet permits the punchings to separate freely after the solder melts. The length of the restricted sections is held within the limits of ± 0.005 inch in manufacture, and a definite amount of solder is applied in joining the punchings, so that the time-current characteristics are accurately controlled for both low-current and surge blowing.

In this manner, low-current "N" ratings of 1, 2, or 3 amp. are obtained with a surge blowing characteristic of a 5-amp. conventional fuse link; both universal cable-type and flip-open type designs are mechanically and electrically interchangeable with conventional fuse links of the same type now in service.

At transformer installations, now using 5-amp. minimum fusing, the Hi-surge fuse links permit improved overcurrent protection with the same freedom from fuse blowing as afforded by the conventional 5-amp. fuse link. When 1, 2, or 3 amp. fusing is used, the new links permit reduced blowing by lightning or other surge currents with the same overcurrent protection as afforded by the conventional fuse links.



CUTAWAY SKETCH of Hi-surge fuse links, (a) flip-open and (b) cable type and (c) two interlocked punchings

Meter Ratchet Has Low-Friction Action

J. S. LINEBACK

Superintendent of Meters
Cincinnati Gas & Electric Co.

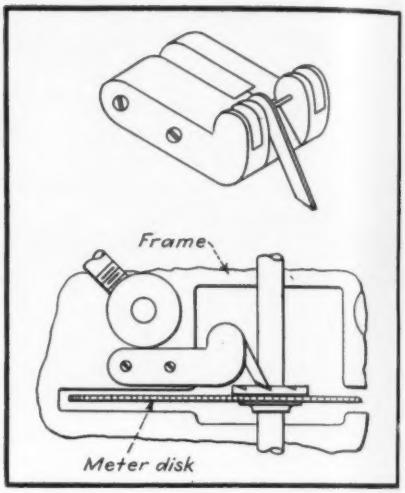
Ratchets for watthour meters are used on the "In" and "Out" meters on interchange-line installations, to prevent reverse rotation of the meter disk. Requirements of such ratchets are positive action, minimum friction, and, of primary importance, that they be readily accessible for cleaning.

Inability of available ratchets for certain types of meters to meet these requirements led to the design and construction of the device shown in the diagrams.

The notched ratchet wheel is pressed directly on the disk shaft. The pawl and shaft are held in a two-piece assembly which is clamped to the meter frame with two set screws.

Outer "ears" of the pawl-shaft assembly permit adjustment of the end play on the pawl shaft. The two-piece pawl assembly, held together with a screw, can be completely removed from the meter and disassembled, thereby permitting thorough cleaning of the pawl shaft bearings.

The pawl is mounted in a near vertical position to minimize its movement and reduce friction. Tests have shown that these devices impose far less friction than those previously used.



PAWL AND RATCHET WHEEL designed for positive action, minimized friction and ready cleaning

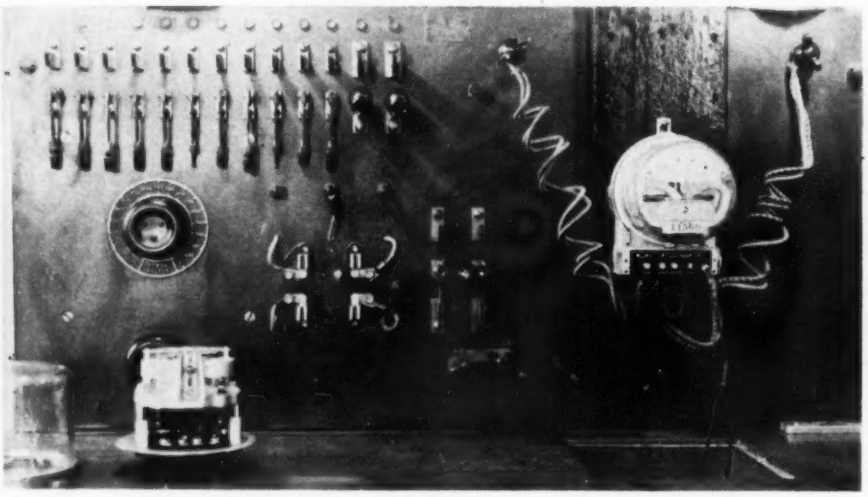
•

Test Board Socket Speeds Production

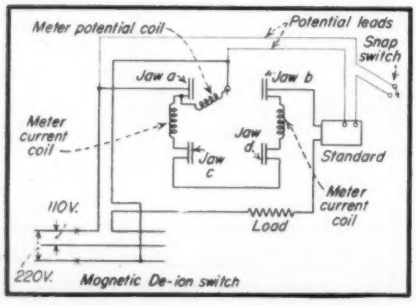
W. T. R. WARD

Meter Supervisor
Public Service Co. of New Hampshire, Nashua, N. H.

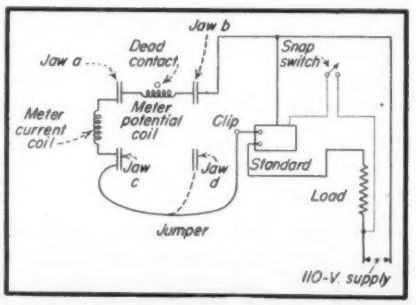
In testing watthour meters it has been found possible to save time by equipping the departmental test board with a terminal base to receive either 2-wire or 3-wire meters of the socket type instead of making cumbersome special connections by hand. The accompanying diagrams show the connections resulting from attaching each specified meter to the board base, fitting the meter contacts into the jaws a, b, c and d. A short jumper is used in testing 2-wire meters, as indicated. Formerly 24, 3-wire meters were tested in a 6-hour day; but with the above arrangement this number can be tested in two hours or one-third of the time.



VIEW OF TEST BOARD showing socket open to receive meter at left center



CONNECTIONS for testing 3-wire meter



CONNECTIONS for testing 2-wire meter

•

Distribution Staff Duties Summarized*

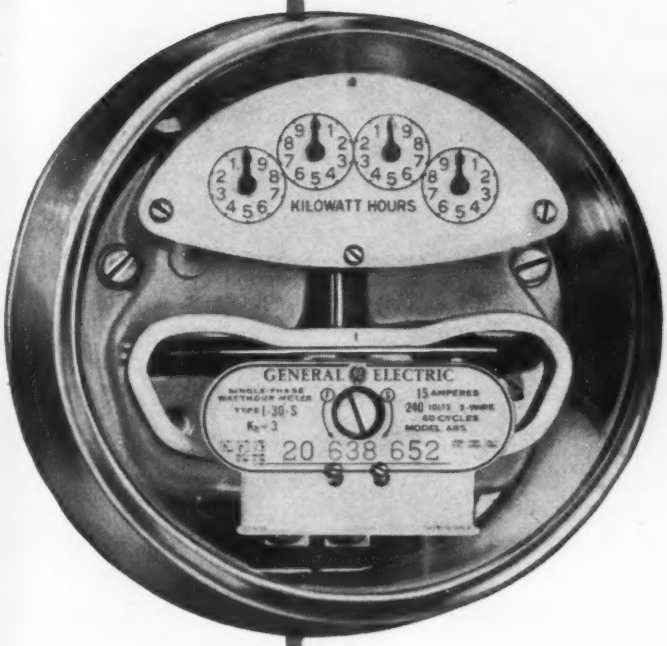
Assistant Superintendent

In a typical Eastern utility company the assistant superintendent of distribution performs assigned special work, and acts for his superior in the latter's absence. He is responsible for making certain that Work Orders are issued on all major projects and for following these up so far as necessary to determine that they are being carried out according to plans and specifications. He sees to it that plans, working drawings and similar information that may be furnished by supervisory or advisory engineers or other outside sources are issued to the proper division heads who are to do the work. Authority to arrange for the supply or temporary transfer of help from one division to another rests in him, subject to keeping his superior informed regarding such transfers and conferring with him before any unusual transfers are effected.

This official is responsible for fault location or coping with any unusual

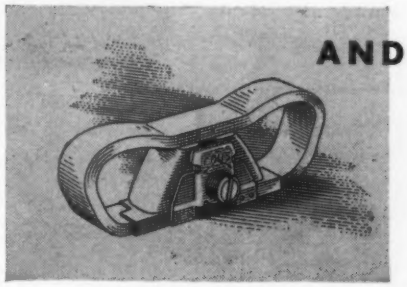
* One of a series of presentations covering the essential duties of officials of a public utility distribution department serving between 50,000 and 75,000 meters. Organization of the distribution department was outlined in ELECTRICAL WORLD, October 13, 1945, page 106.

You can count on the



I-30

FOR MAGNETIC STABILITY



AND NO WONDER! At the heart of this meter is a G-E alnico magnet

This surge-resisting magnet owes its stability to (1) all-welded, one-piece construction, (2) careful control of material and dimensions at every step in manufacture, and (3) the inherently high coercive force of alnico. It helps make the I-30 a meter you can depend upon—a meter that maintains its excellent performance under increasing loads in both urban and rural service.

Include the I-30 in your metering program. It's the safe thing to do. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

WATTHOUR METERS

Headquarters for Electrical Measurement

GENERAL ELECTRIC

201-15-6110

distribution system trouble; for the operation of the system of checking up the performance of periodic work on schedule; and for arrangement of an annual inspection tour of all substations, transformer banks on the company's 13.2-kv. system, network transformer installations, large or important transformer installations on the 2,300-volt system, and any other property or buildings under the department's jurisdiction. This is scheduled for May and June yearly. Division heads in charge of electrical apparatus are required to be present at any such inspections which involve such equipment. An annual tour of the stock room (in May) is also scheduled, with the superintendent and stock room foreman to determine if the necessary materials are on hand, properly stored and all junk disposed of.

Before the 25th of each month a "Percentage of Work Completed" report is prepared by him covering the preceding calendar month. During each December the assistant superintendent causes periodic work calendars for the coming year to be prepared for division heads, all periodic work being scheduled far enough ahead to enable proper preparation to be made for its execution. A duplicate of each key used about buildings under departmental supervision is also required to be kept in his custody. The assistant superintendent is also required to keep informed as to all U. S. governmental regulations affecting the operation of the department, and particularly priority and comparable governmental and other authoritative regulations. It is his duty to see that reports are prepared as required by such regulations.

•

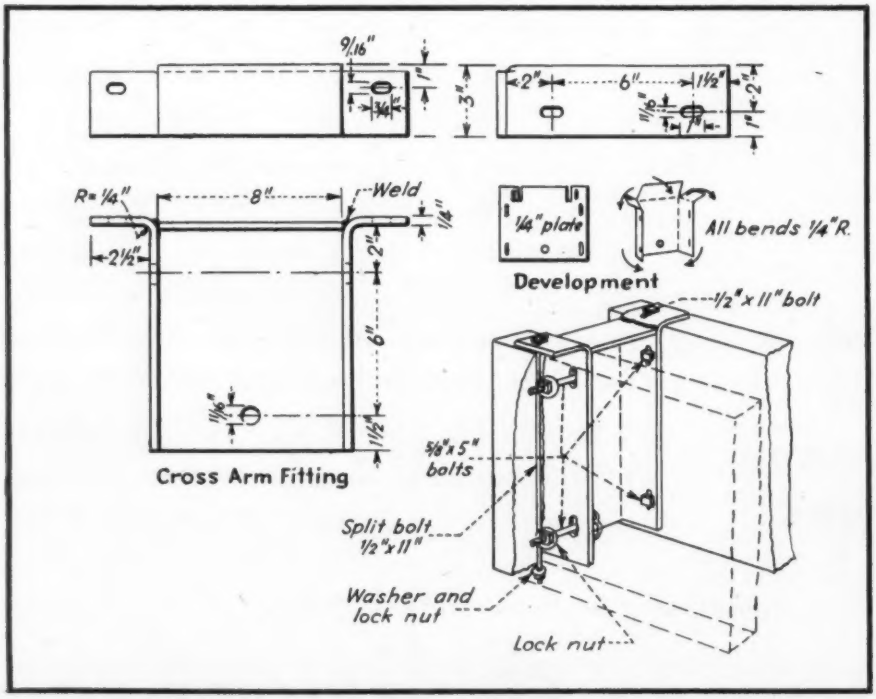
New Phase Assembly Stops Crossarm Splitting

E. H. AIKEN*
Chief Electrical Engineer, Imperial Irrigation District, El Centro, Calif.

Because of the extreme changes in temperature and humidity in the Imperial Valley of California, crossarms warp and split quite badly. It has been found that phase assemblies that rely upon the bolts through the crossarms to take the downward thrust will soon split the crossarms.

Consequently, on a new 92-kv. transmission line a new type of assembly was designed which places the thrust on the top edges of the timbers and the bolts pass through slotted holes which allow them to adjust with the expansion and contraction of the timbers. This new assembly, as shown with side plate removed and omitted, is readily formed from rectangular steel plate. Crossarms used on the line are of the double type with 3-in. by 10-in. by 20-ft. timber on each side of the pole and the special steel phase assembly at each insulator support. All parts and hardware are hot-dip galvanized.

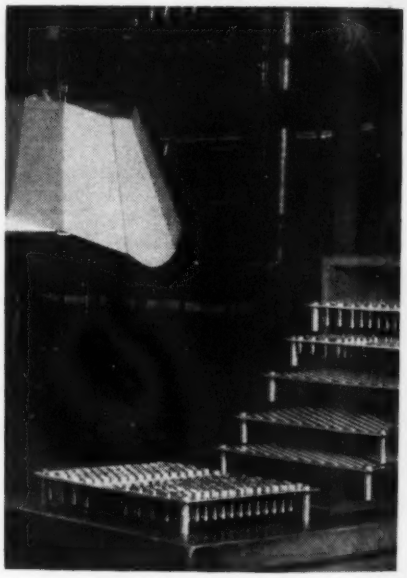
* Now Service Shop Engineer, General Electric Co., Los Angeles.



SUSPENSION INSULATOR SUPPORT made from slotted rectangular steel plate prevents crossarm splitting under conditions of extreme change in humidity

•

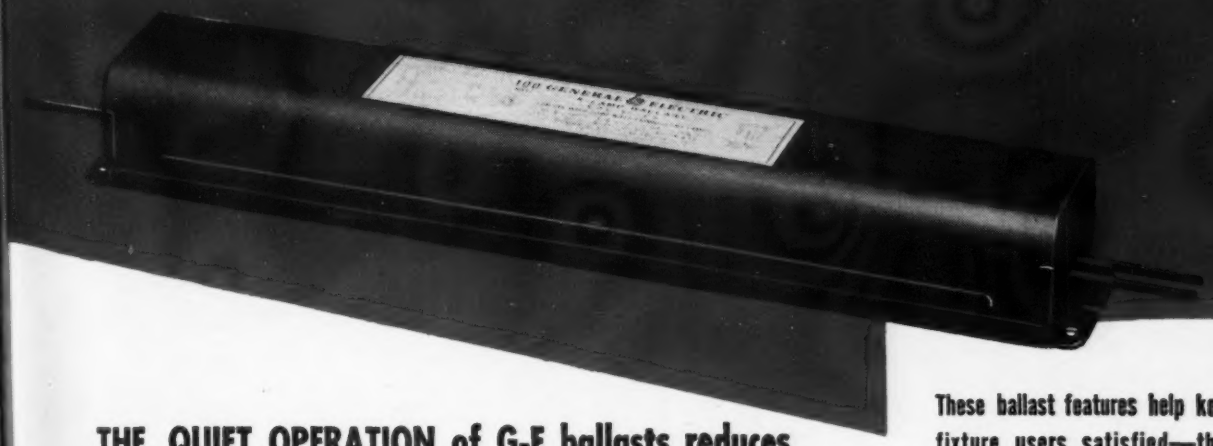
Cabinet Stores 1800 Meter Jewels



ALUMINUM SHELVES rest in slots to store meter jewels in wooden box only 8⅜ in. x 11⅛-in. x 11-in. in outside dimensions. A shelf holds 300 jewels

In the meter department of the Connecticut Power Co., Stamford, a compact arrangement for storing jewels has been provided by a wooden box with ⅛-in. slots, 1⅝-in. apart, which carries six aluminum shelves with perforations ¼ in. on centers, each shelf holding 300 jewels. The shelves consist of two plates each, riveted together, and supported at the corners by metal posts 1⅝ in. high. The perforations are each ¼ in. in diameter, and the plates are each 7¾ in. long by 10½ in. wide. This box normally holds the department's full complement of jewels which have passed inspection, and when closed can be easily moved about in case this becomes necessary. W. H. Parmiter is superintendent of the meter department.

WHY you need this SILENT PARTNER in your fixture business



THE QUIET OPERATION of G-E ballasts reduces noise complaints and promotes customer good will

G-E BALLASTS are so designed and built that hum (present to some degree in all a-c devices) has been reduced practically to the point of inaudibility.

For example, the ballast coils are *machine* wound to eliminate "springy layers," and to provide units of unvarying rectangularity. The cores are stacked automatically from high-quality, low-loss steel laminations that are cut to exact dimensions. Thus, precisely the right amount of core steel can be fitted snugly around each coil, and firmly clamped into position to prevent "play" or shifting of parts—so often a contributing cause of noise.

In addition, after all the various ballast components are assembled in a mechanically strong clamping frame, they are impregnated in a moisture-resistant varnish, and cured by baking, and housed in an unusually heavy-gage steel case. A special compound, that sets like asphalt, is poured (while hot and fluid) over and around all the assembled parts, filling all air pockets and voids and sealing the components to each other and to the ballast case. The result is a solid, cohesive ballast without noise troubles.

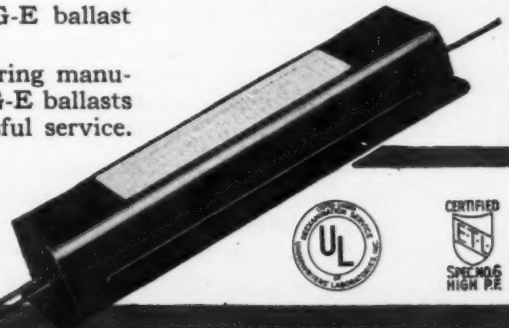
As a final precaution, one of the many tests which every G-E ballast must pass is an exacting noise test.

It is attention to details of this sort, and quality control during manufacture, that are responsible for the fact that, of the 16,000,000 G-E ballasts installed since 1938, 99.5 per cent are still giving quiet, successful service.

Write for Bulletin GEA-3293F for data on our complete line of ballasts for fluorescent lighting. *General Electric Company, Schenectady 5, New York.*

These ballast features help keep fixture users satisfied—they mean added profits for you

1. Low noise level—for satisfied users
2. Long life—for low replacement cost
3. Characteristics matched with lamp—for rated lamp life and light output
4. Dimensions that permit use of one wiring channel for practically all fixtures—for simplified parts inventory and lower fixture cost



BALLASTS
LAMPS
STARTERS
LAMPHOLDERS
CABLE—stand for DEPENDABILITY in fluorescent lighting

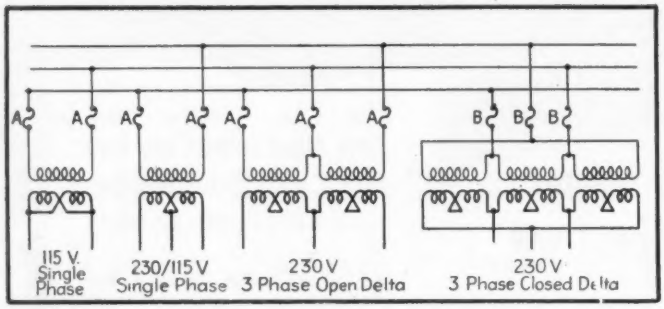
Buy all the BONDS you can —and keep all you buy

GENERAL ELECTRIC

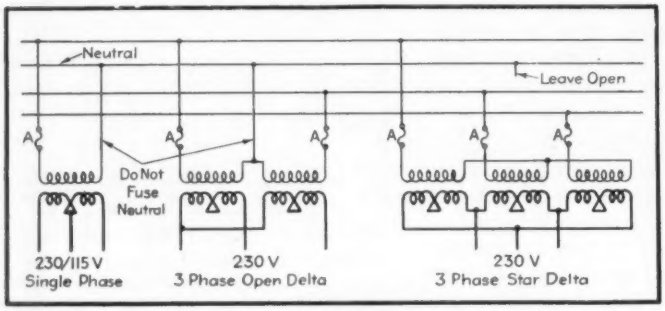
HOW TO DETERMINE SIZES OF FUSES FOR 2300 TO 6900-VOLT TRANSFORMER CUTOUTS

Accompanying connection diagrams and tabulations have been developed to select fuse sizes for transformer cutouts used on distribution systems. The data are adapted from specifications of the West Penn Power Co., Pittsburgh, Pa.

Transformer Connections



Primaries: 2,300-, 4,600- or 6,900-volt; 3-phase; 3-wire
Secondaries: 115- or 230-volt; single- and 3-phase



Primaries: 4,000-, 8,000- or 12,000-volt; 3-phase; 4-wire
Secondaries: 230, 230/115-volt; single- and 3-phase

NOTES: **A and B are references to tabular column headings**
For 4,000-volt circuits use 2,300-volt transformers
For 8,000-volt circuits use 4,600-volt transformers
For 12,000-volt circuits use 6,900-volt transformers

Application of Fuse Cutouts and Switches at Transformer Installations

Volts	Connected (See Transformer Connections)	Range of Transformer Sizes, kva		
		50 amp. Cutout	150 amp. Cutout	Open-type Fuse Switch
2300	A — Single phase A — Open delta A — Star	1½–50	75–200	.....
2300 4600	B — Closed delta A — Single phase A — Open delta	1½–37½ 1½–100	50–100 150–200	....
4600 6900	B — Closed delta A — Star B — Closed delta	1½–75	100–200	..... up to 200 up to 100

Fuse Sizes for Transformer Cutouts

Transformer Size, kva.	2,300-Volt Transformers		4,600-Volt Transformers		6,900-Volt Transformers	
	(A) Connected Single Phase, Open Delta or Star	(B) Connected Closed Delta	(A) Connected Single Phase or Open Delta	(B) Connected Closed Delta	(A) Connected Single Phase, Open Delta or Star	(B) Connected Closed Delta
	Fuse Link, amp.					
1½	10	10	10	10	10	10
3	10	10	10	10	10	10
5	10	10	10	10	10	10
7½	10	20	10	10	10	10
10	20	20	10	10	10	10
15	20	30	10	20	10	10
25	30	50	20	20	10	20
37½	50	75	20	50	20	30
50	50	75	30	50	20	30
75	75	100	30	50	20	50
100	75	150	50	75	30	50
150	150	200	75	100	50	75
200	150	250	75	150	50	100

NOTE: Refer to Engineering Dept. for fuse cutout and oil circuit breaker.

Fusing Notes

1. Determine size of fuse link: (a) for transformer fuses, see table of fuse sizes for transformer cutouts; (b) for line fuses, check with Division Engineer.

2. In fusing dropout or indicating cutouts, be sure that the latching device on the tube will take the contact pressure when the cutout is closed. The fuse link is attached to hold the latching device in position.

3. Line sectionalizing fuses will be specified by the Engineering Department.

Fusing Value of Copper Wire

Size of Wire, A.W.G.	12	14	16	18	20	22	24
Current to Fuse Wire, amp.	235	165	115	80	60	40	25
Equivalent Size of Fuse Link, amp.	150	100	75	50	30	20	..

How KILOVAR CONTROL improved substation bus voltage at Georgia Power

Automatically switched capacitors chosen as most flexible and economical method

THE Georgia Power Company found it desirable to control the bus voltage at its 110,000- to 13,800-volt Augusta substation to prevent widely varying voltage levels between periods of full load and light load. Six of our attractively styled Pyranol capacitor equipments were chosen for the job. Each equipment is rated 2520 kva.

The stepdown transformers at the substation were set on the proper high-voltage tap to give the desired low-voltage bus voltage at light loads. As the voltage drops with increasing loads, the 15,120-kva capacitor bank is automatically connected to the circuit in six equal steps, supplying kilovars to the system and keeping the bus voltage up.

As expanding loads increase the minimum demand at Augusta, there will be less difference in voltage between light load and full load. The transformer tap setting can be changed, and some of the six capacitor equipments can be easily moved to other points of the system that in the future may need reinforcement.

Thus, by selecting capacitors for this installation, Georgia Power not only improved present operating conditions but also provided a flexible source of kilovars for future needs.

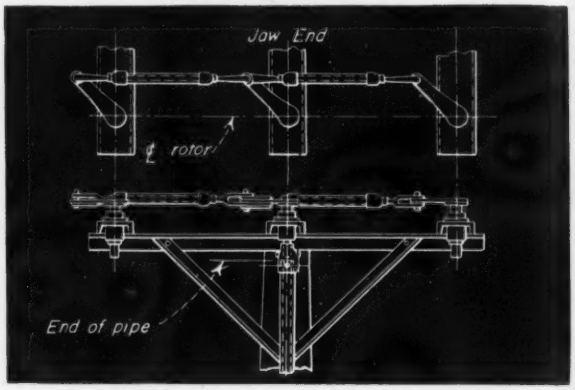
We will be glad to help you analyze your kilovar requirements and estimate the benefits of Pyranol capacitor banks on *your* system. Ask for Publication GEA-4225. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

Keep on buying BONDS—and *keep all you buy*

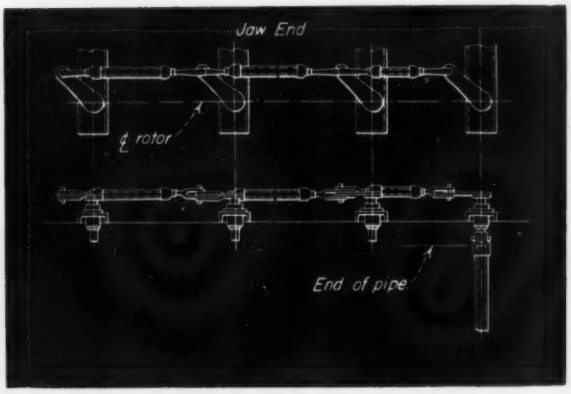
GENERAL ELECTRIC

FOUR ARRANGEMENTS OF OPERATING MECHANISMS FOR AIR SWITCHES*

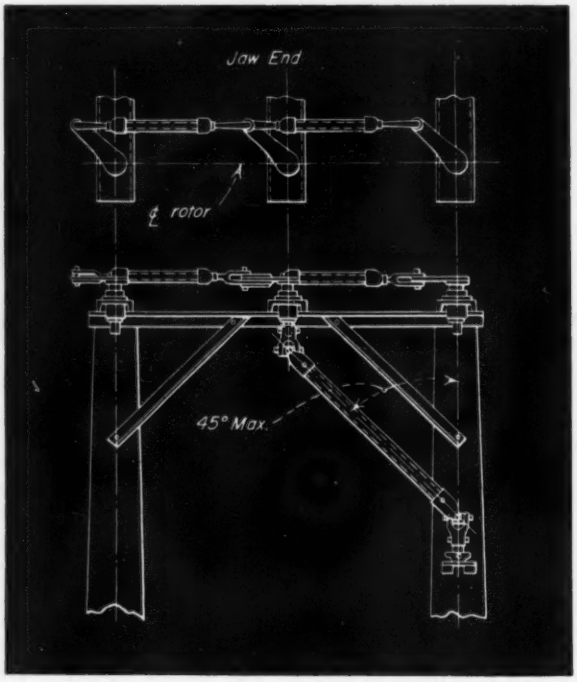
Switch blades can be operated individually, or in gangs by some form of an interconnecting link from the actuating source. In general, the same operating linkages which are commonly used for manually operated air switches may be used for automatic air switches. For automatic air switches, however, the elimination of excessive drag is more important than it is for manually operated switches. Therefore, automatic air switch operating linkages should be kept simple and efficient.



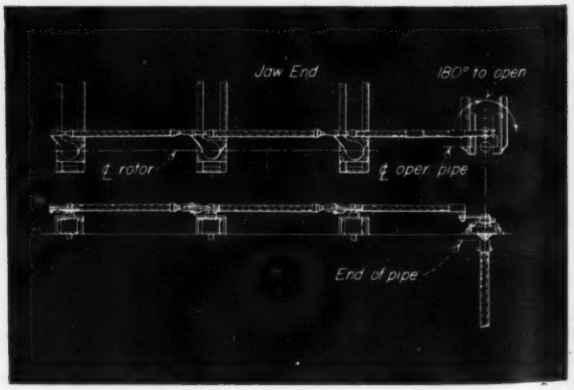
DIRECT operating switch mechanism, showing connecting linkage. Actuating device drives through the vertical operating pipe fastened directly to one of the switch rotors



OFFSET-INDIRECT switch operating mechanism with added bearing. The actuating device cannot be located directly below any of the switch rotors and a fourth, or offset bearing is used. Sometimes two offset bearings are necessary



OFFSET UNIVERSAL switch operating mechanism where the actuating device cannot be located directly below any of the switch rotors. Universal joints are used for the offset drive



OFFSET-INDIRECT switch operating mechanism with a reduction gear used in place of the offset bearing. This gear is used with operating mechanisms that are arranged for motor drive

** Aapted from advance pages of a forthcoming bulletin by Railway and Industrial Engineering Co., Greensburg, Pa.*

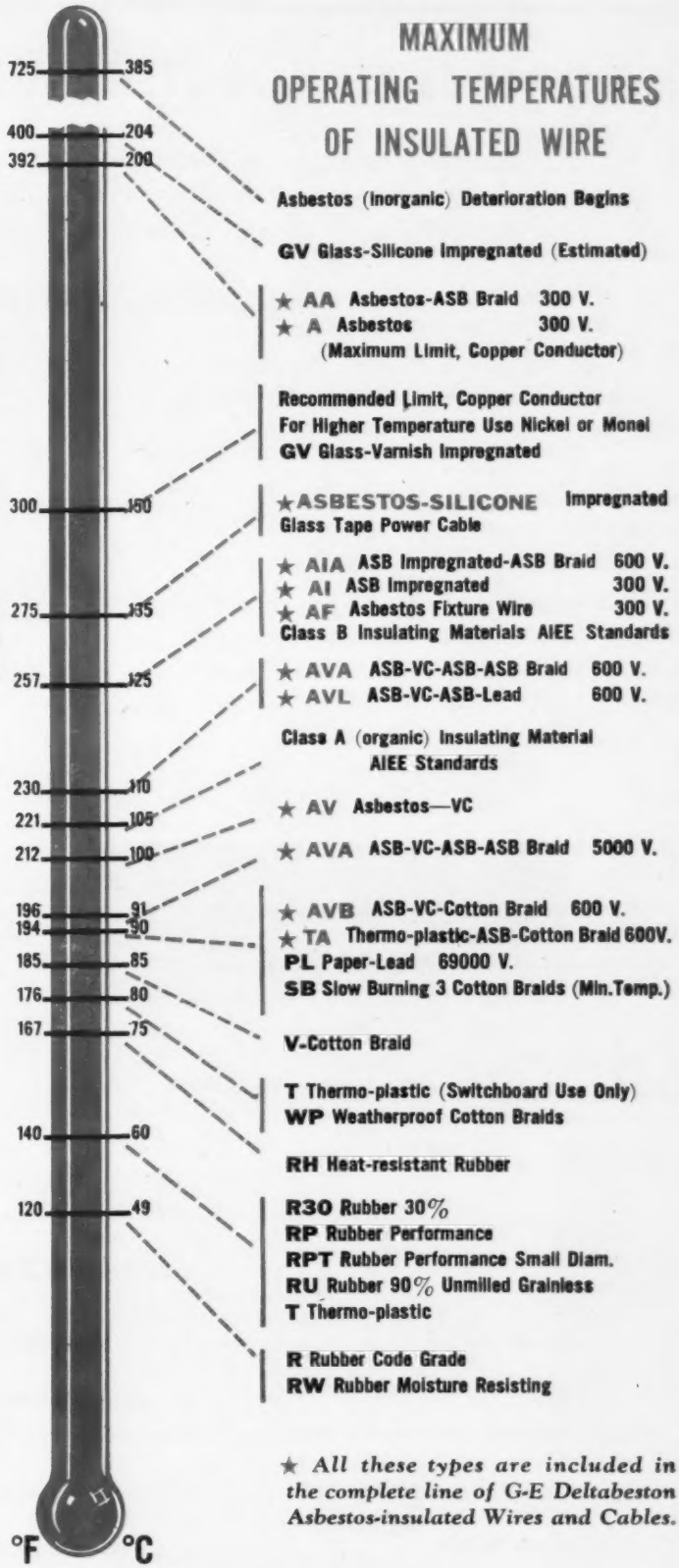
HERE ARE THE FACTS

WHY You Should Use DELTABESTON ASBESTOS-INSULATED CABLES

As operating temperatures on the illustrated thermometer increase, you'll note that asbestos-insulated wires are recommended more frequently than other types. That's why you'll want to investigate Deltabeston for wiring installations exposed to constant high temperatures. These heat-resistant cables are designed for control, lighting and power circuits. Regardless of what type of cable you require, where heat is a problem, Deltabeston fits the job.

● ● ●

The Deltabeston catalog will help you solve your cable problems. For your free copy, write to Section Y1151-9, Appliance and Merchandise Dept., General Electric Co., Bridgeport, Conn. All Deltabeston Wires and Cables are distributed nationally by Graybar Electric Co., General Electric Supply Corp., and other G-E Merchandise Distributors.



★ *All these types are included in the complete line of G-E Deltabeston Asbestos-insulated Wires and Cables.*

Hear the General Electric radio programs: "The G-E-All Girl Orchestra" Sunday 10 P.M. EWT, NBC. "The World Today" news every weekday 6:45 P.M. EWT, CBS. "The G-E House Party" Monday through Friday 4:00 P.M. EWT, CBS.

GENERAL ELECTRIC

FORMULAS FOR HIGH-FREQUENCY HEATING*

Accompanying nine dielectric heating formulas are a supplement to five general high-frequency heating formulas and eight induction formulas presented in Electrical World, November 10, 1945, page 152.

DIELECTRIC HEATING FORMULAS

1. Capacity of a Parallel Plate Capacitor

$$C=0.224\times e'\times\frac{A}{D}\times10^{-12} \quad \text{(farads)}$$

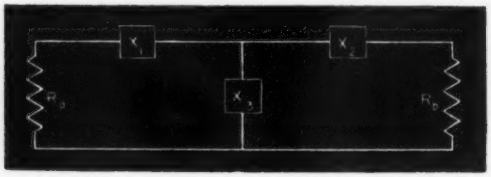
2. Power Input into a Dielectric

$$P_v=1.41\times f_M\times E_1^2\times e'' \quad \text{(watts/cu.in.)}$$

3. "T" Network Equations

$$\frac{R_a}{R_b}=\frac{X_1+X_3}{X_2+X_3}$$

$$-R_aR_b=X_1X_2+X_1X_3+X_2X_3$$



4. Effective Series Resistance of a Capacitor

$$R=X_c\times(PF)=\frac{(PF)}{2\pi fC} \quad \text{(ohms)}$$

5. Dielectric Loss Factor

$$e''=e'\times(PF)$$

6. Wave Length Along Electrodes

$$\lambda=\frac{984}{f_M\sqrt{e'}} \quad \text{(feet)}$$

7. Dielectric Heating with an Air Space between Load and Electrodes

$$E_1=\frac{E}{t+Ge'} \quad \text{(kv./in.)}$$

8. Capacity of Parallel Plate Capacitor with Parallel Layers of Different Dielectrics

$$C=\frac{0.224\times A\times10^{-12}}{\left[\frac{a_1}{e'_1}+\frac{a_2}{e'_2}+\ldots.+\frac{a_n}{e'_n}\right]} \quad \text{(farads)}$$

9. Voltage Gradient in any Dielectric Layer in Parallel Plate Capacitor with Parallel Layers of Different Dielectrics

$$E_k=\frac{E}{e'_k\left[\frac{a_1}{e'_1}+\frac{a_2}{e'_2}+\ldots.+\frac{a_n}{e'_n}\right]} \quad \text{(kv./in.)}$$

NOMENCLATURE

A = electrode area (sq. in.)

a_1 = thickness of first layer of dielectric (inches)

a_2 = thickness of second layer of dielectric (inches)

a_n = thickness of *n* th layer of dielectric (inches)

C = capacity (farads)

D = distance between electrodes (inches)

E = total voltage across electrodes (kilovolts)

E_1 = voltage gradient in dielectric (kv./in.)

E_k = voltage gradient in *k* th dielectric layer

e' = dielectric constant

e'_k = dielectric constant of *k* th dielectric layer

e'_1 = dielectric constant of first dielectric layer

e'_2 = dielectric constant of second dielectric layer

e'_n = dielectric constant of *n* th dielectric layer

e'' = loss factor

f = frequency (cycles/sec.)

f_M = frequency (Mc/sec.)

G = thickness of air space (inches)

P_v = power density (watts/cu.in.)

PF = power factor

R = resistance (ohms)

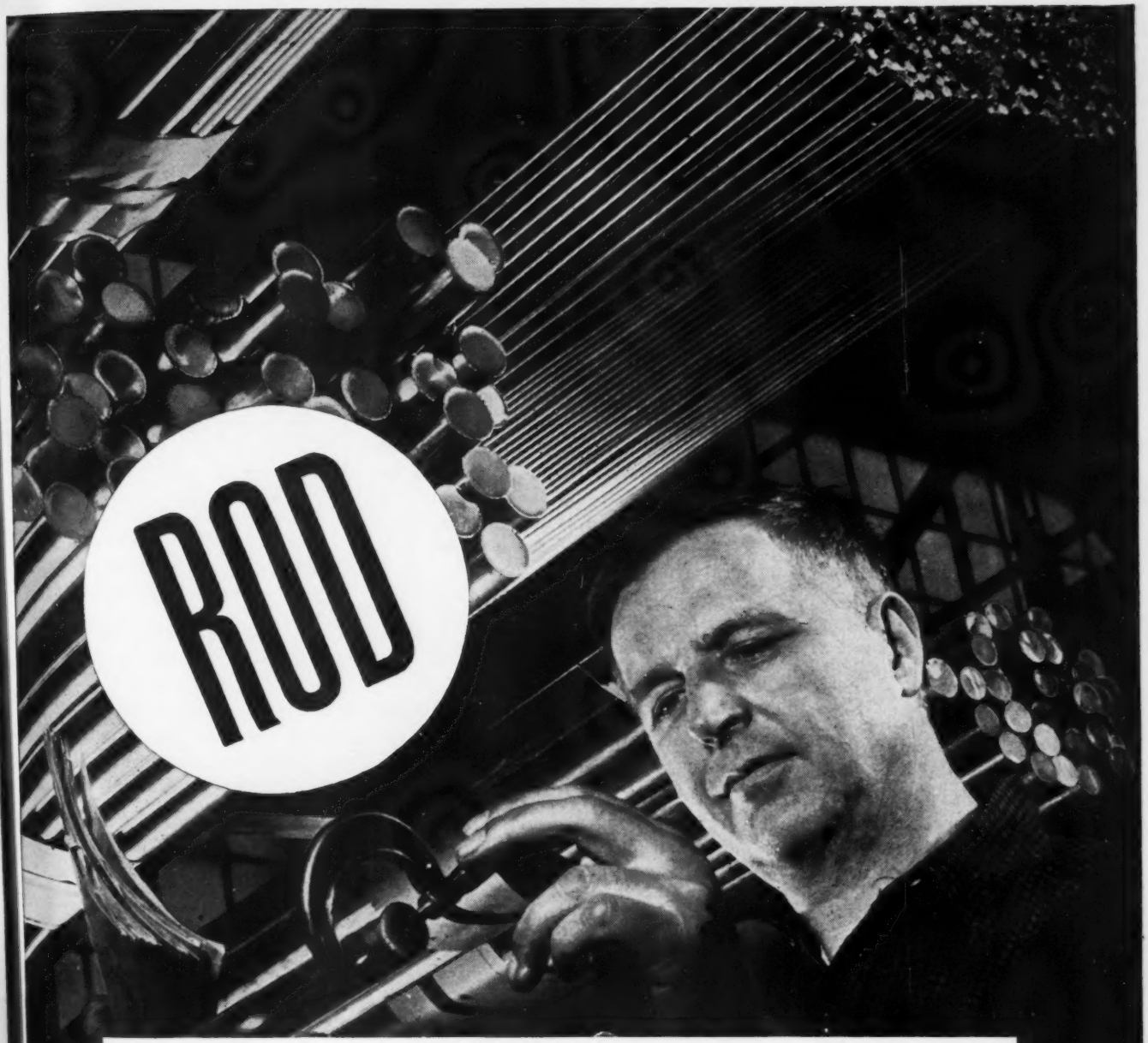
t = thickness of work (inches)

X = reactance (ohms)

X_c = capacitive reactance (ohms)

λ = wave length (feet)

*Compiled by the Industrial Electronics Division, Westinghouse Electric Corp., Baltimore, Maryland.



. . . by REVERE

Revere NOW offers rod in a wide variety of alloys and the following shapes: round, hexagonal, octagonal, square, special. The physical characteristics of this rod vary with the alloy of which it is made, and the nature of our processing of it. Thus we can furnish you with rod suitable for practically any fabrication process and end use.

We offer Revere rod in the following:

Copper	Manganese Bronze
Free-Cutting Copper	Herculoy
Free-Cutting Brass	(Silicon Bronze)
Brass (not free-cutting)	Aluminum Bronze
Red-Brass	Aluminum-Silicon Bronze
Naval Brass	Nickel Silver
Muntz Metal	Magnesium Alloys
Commercial Bronze	Aluminum Alloys
Roman Bronze	Special Alloys

Available in coils or straight lengths, depending on size and composition. For full details, prices and deliveries, consult your Revere Distributor or us. The Revere Technical Advisory Service will gladly work with you in selecting the rod best fitted for your needs. For this assistance, which is given without obligation, just write the nearest Revere Office.

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Discharge Current of Okoprene

In the search for a non-metallic, non-fibrous sheath for aerial cable, the compound Okoprene (contains 60 percent Neoprene and no rubber) was applied to determine its suitability as insulating material.

As one of the problems of aerial non-metallic shielded cable is leakage current flow, a comparison of the surface leakage resistance of braids and the compound was made. The comparison was reported by Robert J. Wiseman, Chief Engineer, The Okonite Co., Passaic, N. J., in a paper, "Factors Which Influence Aerial Cable Design and Operation," presented recently before the Transmission and Distribution Committee of the Edison Electric Institute.

After determining the values of surface resistivity for braids and Okoprene, both wet and dry, the amount of surface discharge current was calculated for different distances between grounding points, using standard transmission line formulae. They could not be measured because of the low magnitude of currents involved. However, similar curves have been actually measured with lower surface resistances and longer lengths and found to check the calculated curves.

The accompanying graph shows the calculated values of discharge current for the dry and wet conditions. The top curve is for a braided cable under wet conditions. The second curve is for the same cable with a dry braid. The surface resistance of the wet braid is about 50 megohms per inch and for the dry braid about 20,000 megohms per inch. The dry braid is satisfactory from a discharge viewpoint, but braids take up moisture, so this desirable condition will only exist in a dry hot atmosphere. The two bottom curves are for the Okoprene covered cables. The currents are about one-third of the dry braid and almost the same for the wet and dry condition because the surface resistance is closely the same: 200,000 megohms per inch for wet surface and 250,000 megohms per inch for a dry surface.

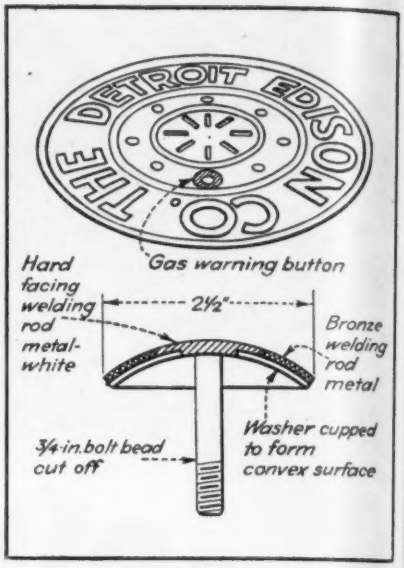
A tabulation of test data at which corona occurs will be presented in a subsequent issue.

•

Button in Cover Marks Gassy Manholes

As a result of a suggestion by L. Archambeau of the underground lines department, all manholes on The Detroit Edison Co. underground system known to contain a dangerous mixture of gas are now marked with a special warning button to advise workmen that extra care should be taken in removing the cover or entering the manhole.

The 2½-in. diameter button, shown, is bolted in a vent hole in the manhole cover and is easily identified by its characteristic white metal center and ring of yellow brazing metal around the outer edge. Warning buttons are installed by the safety division at the same time that the warning signs are attached to the manhole ladder. Both button and sign are removed when the manhole tests "clear."


THE DETROIT EDISON CO.
Gas warning button
Hard facing welding rod metal-white
2½"
Bronze welding rod metal
Washer cupped to form convex surface
¾-in. bolt head cut off

CHARACTERISTIC yellow and white button in vent hole of manhole cover warns of dangerous gas mixture

•

Method of Preventing Mercury from Drossing

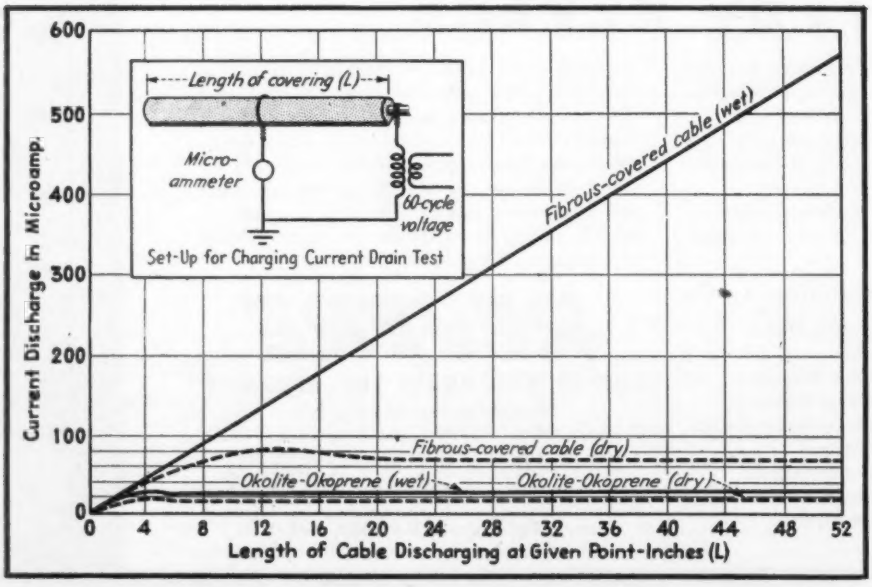
RUDOLPH GASSNER
Operator, Philadelphia Electric Co.

Drossing of the mercury in the breathing regulators which are installed on the Inertaire transformers has necessitated constant maintenance. When drossing occurs, the gauge glass becomes obscured so that it is impossible to obtain accurate pressure readings.

A series of tests has been made to determine the causes of and conditions necessary for the dross formation. Results have shown that one of the main causes of the drossing results from filling the regulator with mercury before the gasket cement is dry. There are other causes but these can be prevented by the following maintenance practices:

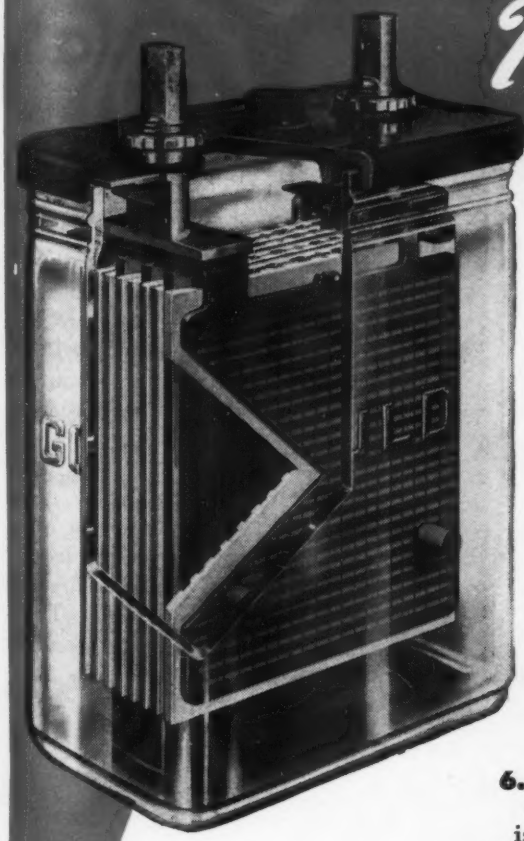
1. Internal parts of the regulator must be scraped clean, washed with soap and rinsed with clear water.

2. Paint the inside of the cover, the body and both sides of the plates with General Electric Glyptal using a clean brush. (In fact, Glyptal is the



COMPARATIVE VALUES of charging current drain for two kinds of insulated cable, 4/0, single-conductor, 4150-volt, under wet and dry conditions

WHY DO ENGINEERS SAY *Planté* IS THE BEST?



1. One-piece, pure lead positives provide full plate performance throughout battery life.

2. One-piece, pure lead positives insure highest discharge rates for unfailing operation of electrical equipment.

3. Current output of one-piece, pure lead positives averages more than 23% above that of equivalent batteries.

4. One-piece, pure lead positives without holding structures provide longest possible life. They prevent partial deterioration that results in loss of capacity.

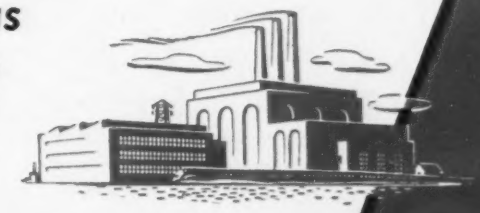
5. A dense film of active material covers entire plate area. This prevents peroxidization and disintegration, both of which result in lowered current output and shortened battery life.

6. One-piece, pure lead positives give greatest conductivity. This is due to an active material which is an integral part of the plate itself. Dependence upon mechanical electrical contact is avoided.

. . . BEST FOR UTILITY CONTROL AND STANDBY OPERATIONS

In many of America's largest electric generating plants the Gould Plante has proved itself the most dependable of all storage batteries. It delivers a high current output for speedy instrument operation and, because of its exceptionally long service life, over-all operating costs are low.

Gould also builds two other types of stationary batteries, Kathanode and Dreadnaught. Write Dept. 1811 for Catalog 1000 on Gould Sealed-in-Glass Batteries for Stationary Applications.



GOULD *Planté*

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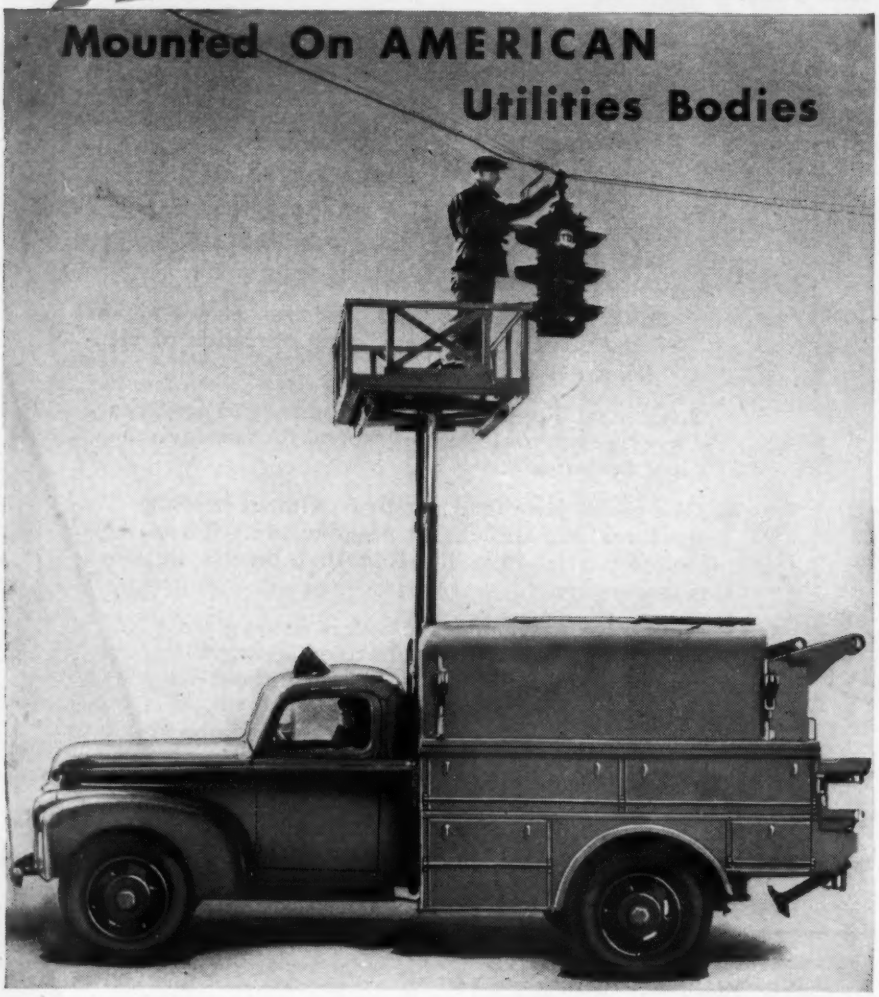
American BIRD-WHITE TOWER LIFTS



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Here's a simple easy, efficient and economical method for service and maintenance of your signal, street and highway lights, for trimming trees and for much of your heavy line work on the highways. It is a real time saver and assures safety and comfort to your crew.

The American Bird-White combination equipment offers; — low initial heights, in some instances almost flush fittings — extreme elevations, up to 28 feet — sturdy construction, without excess bulk — rigid stability — elimination of sidesway at all tower elevations — assured with specially designed hydraulic jacks. Trouble-free high pressure rotary pump actuated by a power take-off permits smooth operation in the raising and lowering of the tower controlled from the lift platform.

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THE American COACH & BODY CO.
PUBLIC UTILITIES EQUIPMENT FOR MOTOR VEHICLES

only material used, both as a paint and a cement).

(a) Use gasket made of $\frac{1}{8}$-in. cork. Paint, first coat to be a half and half, thinner mixture.

(b) When assembling, gasket is again painted with an unthinned mixture. Shellac is insufficient.

(c) Leave mercury filling and drain plugs off regulator for a minimum of 24 hours after assembly to dry the material used as a gasket cement.

3. Use new or distilled mercury. Ordinary filtered mercury is unsatisfactory as is mercury that may have been exposed to sulphur fumes.

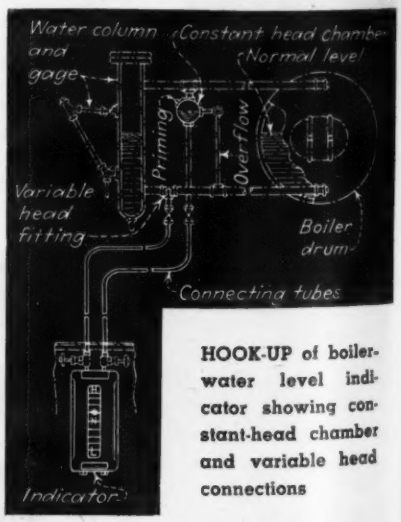
4. No metals except platinum and iron should come in contact with the mercury. When filling, a painted funnel should be used.

Regulators, which have been cleaned and filled following these practices, have been in service for more than one and a half years with no visible dross formation. Previously, the regulators were taken out of service every three months to remove the dross formation.

•

Boiler Water Indication "Out of Dark" into "Light"

Boiler water level indication at the Vienna generating station of the Eastern Shore Public Service Co., Salisbury, Md., has been brought "out of the dark" and placed "in the light" on the boiler instrument panel. Its advantage lies in the fact that it is visible at all times and from all positions while the watch engineer scans the board.

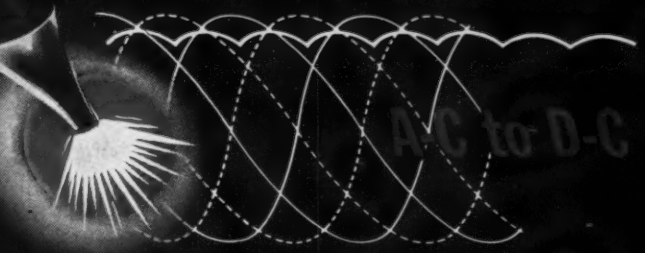


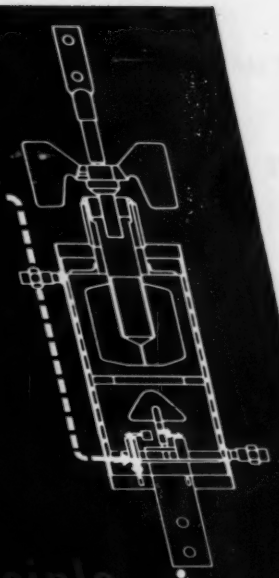
HOOK-UP of boiler-water level indicator showing constant-head chamber and variable head connections

This Yarway remote water level in-

POWER CONVERSION

Spark Plug

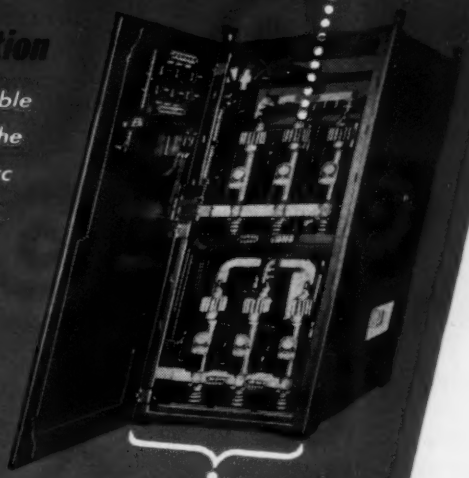




Westinghouse IGNITRON Principle

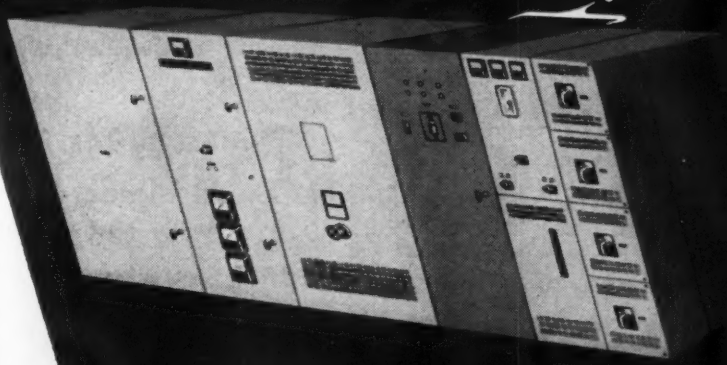
Heart of the IGNITRON Unit Substation

The Westinghouse Ignitron Principle provides a reliable method of starting an arc in a few micro-seconds, at the beginning of each conducting period and permits the arc to extinguish when the anode is not conducting current. This principle permits use of minimum shielding, thereby lowering arc losses. These inherently low losses provide remarkably high efficiency at low loads, as well as under heavy load conditions. The ignitron rectifier consists of the correct number tubes, for the required KW output. Each tube is complete with its anode, cathode and ignitors and is evacuated and permanently sealed at the factory



ASSURES CONTINUOUS SMOOTH FLOW OF CURRENT

CONSIDER ALL ADVANTAGES OF POWER CONVERSION AT ITS BEST



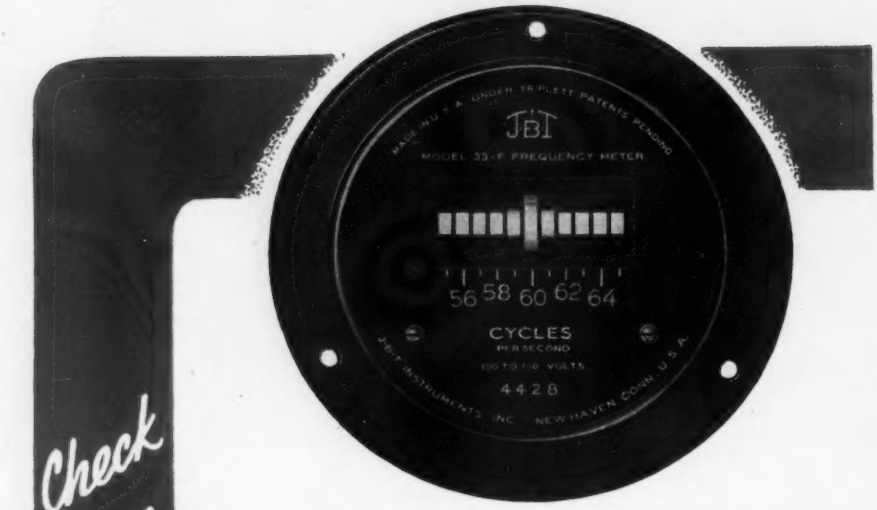
Consult Westinghouse

Get all the facts of this Ideal Power Unit. Call at your nearest Westinghouse office or write for B-3646-"IGNITRON UNIT SUB-STATION"—Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

Westinghouse *Electronics at Work*

J-10299

How to Get Your Money's Worth in FREQUENCY METERS



Model 33-F, Full-cycle increment, shown indicating frequency of 60 cycles. Black dial for special application.

Check These Points

Here are the facts on J-B-T VIBRATING REED FREQUENCY METERS

ACCURACY

Half-cycle increment, ±0.2%; full-cycle increment, ±0.3%. This accuracy is not affected by normal *temperature* change, *wave form* or *external magnetic* fields.

COMPACTNESS

Made in several sizes, most popular of which is the standard 3¼" panel mounting model. Also made to meet C39.2-1944 ASA specifications and Jan-I-6 for mounting and stud size of Electrical Indicating Instruments. No external reactor.

WEIGHT

Model 31-F, 3½ inch, 5 reeds, weighs only 0.54 lb; Model 33-F, 3½ inch, 11 reeds, 0.59 lb. Other models are correspondingly *light*.

VOLTAGE VARIATION

Will operate on voltages as low as 8 volts. Standard 110-115 volt models will operate satisfactorily over range of 100 to 130 volts. Also made for narrower voltage variation if desired. (Incidentally, current consumption is low. For Model 33-F, for example, ½ watt at 115V.)

RUGGEDNESS

No parts to wear out or get out of calibration. All are securely anchored to the base with lock washers at every critical point. The only movement is at the free end of the spring steel reed. J-B-T meters on portable field equipment have established an enviable performance record.

J-B-T Vibrating Reed Frequency Meters are available for frequencies from 12 cycles to 525 cycles with various reed groupings, increments and case sizes. For additional facts on the complete line, send for Bulletins VF-43, VF-43-1A (400 cycle Meters) VF-43-1B (2½" sizes), and VF-43-1C (interesting new applications).

J-B-T

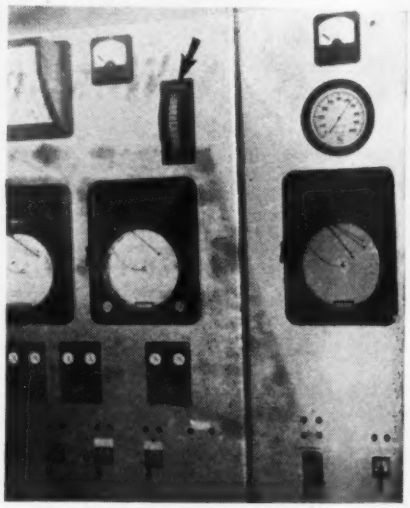
(Manufactured under Triplett Patents and/or Patents Pending)

J-B-T INSTRUMENTS, INC.

439 CHAPEL STREET • NEW HAVEN 8, CONNECTICUT

dicator was installed recently on the 700 psi. boiler which supplies steam to the new 7,500-kw. generator. The indicator which is mounted on the panel is connected to two fittings on the boiler drum by two ½-in. steel tubes. Changes in water level cause corresponding changes in static head in one of the tubes while pressure in the other remains constant since it is connected to a constant-head chamber.

Variations in the differential pressure cause a movement of the diaphragm in the panel instrument—in direct proportion to the variation,



INDICATOR mounted on the boiler instrument panel can be easily seen at all times and from all angles

and these, in turn, are transmitted to the indicator by a magnetic interlinkage.

The scale, which is illuminated, is easy to read since the normal operating range is colored green and the variations from normal (high and low levels) at the top and bottom of the scale are red. This makes it possible for the watch engineer to obtain water-level indication without squinting at the gage glass on the boiler top.

•

12-Kv. Insulators Washed with Hot-Stick Brush

After years of dry wiping 12-kv. insulators on hot lines without entirely satisfactory results, R. B. Windle, hot-stick foreman of Pacific Gas & Electric Co. in the East Bay Division, has developed the simple expedient of attaching an ordinary window washer's brush to a hot-stick

Labeling

Grade labeling, in its usual significance, can carry for either producer, distributor or purchaser only limited assurance concerning quality and value. ETL determination, after independent investigation, offers advantages to producers, distributors and the public, whether the results be utilized privately for guidance of producers, or publicly for assurance of purchasers.

★

Brochure and pamphlet
"CERTIFICATION THAT IS VALID"
supplied upon request

ETL Known by Test

ELECTRICAL TESTING LABORATORIES, INC.

2 EAST END AVENUE AT 79th STREET NEW YORK 21, N. Y.

In Severe Locations *Install* G-E WHITE RIGID CONDUIT

G-E White Rigid Conduit will give permanent protection to wiring in the severest locations. It is resistant to heat, flame, cold, moisture, gas, alkalies and mechanical injury.

Hot-dipped Galvanized

G-E White is heavily coated with zinc inside and outside by immersion in molten zinc—the hot-dipped galvanizing method. This method provides the most durable coating of pure zinc that can be applied by any process. In addition, G-E White has a coating of baked Glyptal inside and out.

Easy to Install

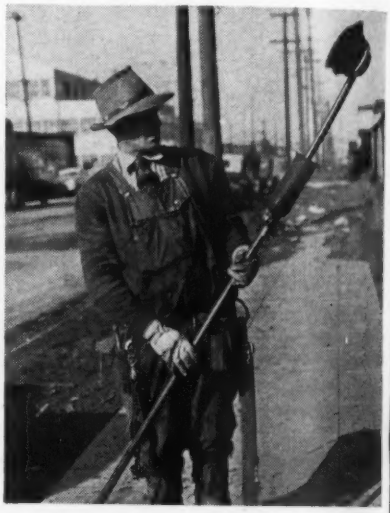
G-E White is easy to install. It is uniform. It has accurate threads. Its smooth interior surface aids wire pulling. (Another G-E conduit, G-E Black, is also available. This conduit is enamel-coated and is recommended for interior use where conduit is exposed to chemical corrosion.)

For further information see the nearest G-E Merchandise Distributor or write to Section C1152-9, Appliance and Merchandise Dept., General Electric Company, Bridgeport, Conn.

GENERAL ELECTRIC

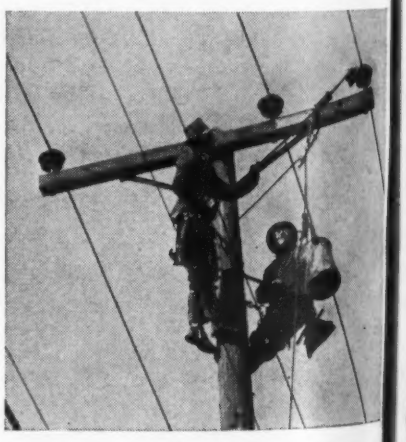
and washing the insulators from a canvas bucket. This has proven to clean insulators thoroughly under all conditions and is so quick and satisfactory that the method will be used by other divisions of the company.

To prevent water from running down the handle of the hot-stick, an ordinary rubber switch-hook guard is placed about 18 in. below the brush. As a further safety precaution a piece



WASHING INSULATORS with window washer's brush on end of hot-stick proves safe and effective. Rubber guard 18 in. below brush prevents water from running down handle

of bakelite tube 2 ft. long is used on the brush end of the stick. This piece of bakelite is covered with heavy grease when washing is being done, so that the water gathers in globules and

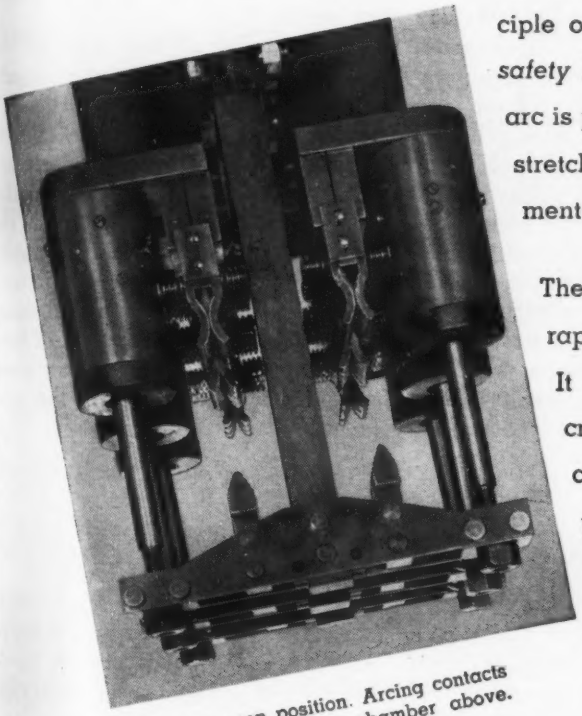


WASHING 12-KV. INSULATORS on energized lines, with hot-stick brush. Water is in convas bucket. One lineman stands by as a safety measure

thus breaks up any continuity of a possible water path down the stick. There appears to be no safety reason why the same method cannot be used on 22-kv., or even 60-kv., lines.

ROLLER-SMITH BREAKER

Gives 5 Cycle Opening with newly discovered EXOTHERM principle of Arc Extinction - - -



Breaker in open position. Arcing contacts shown with quenching chamber above.

THE new Roller-Smith oil circuit breakers with the Exotherm principle of arc extinction give 5 cycle opening consistently, *a 38% safety factor over present accepted standards.* That's because the arc is put out by use of its gas generated energy instead of merely stretching the arc. Users are assured greater protection to equipment by this higher opening speed.

The operation of a confining chamber to quench the arc rapidly is based on the known properties of gas conductivity. It decreases with decrease in gas temperature and also decreases with an increase in pressure. In the quencher the cooling of the arc extracts its energy and reduces the temperature. At the same time the enclosure builds up the gas pressure so that it becomes less conducting and the combination puts out the arc.

The greater speed on opening cuts down contact burning and thereby reduces contact maintenance. It also gives improved protection to equipment against short circuits because of the higher speed of opening.

Confining the gas within the quenching chamber to put out the arc keeps the pressure within the tank at a safe nominal value.

For full information on the Exotherm principle applied to Roller-Smith oil circuit breakers, write to dept. EW-5

SMITH

Oil Circuit Breakers

BETHLEHEM·PENNSYLVANIA

In Canada: Roller-Smith Marsland, Ltd., Kitchener, Ontario

STANDARD AND PRECISION ELECTRICAL INSTRUMENTS • AIRCRAFT INSTRUMENTS • SWITCHGEAR
AIR AND OIL CIRCUIT BREAKERS • ROTARY SWITCHES • RELAYS • PRECISION BALANCES

LOAD BUILDING

Commercial · Industrial · Residential · Rural

Adequate Wiring Pushed at Boston

Adequate wiring promotion in eastern Massachusetts is taking a new lease of life under the auspices of the Electric Institute of Boston, Inc., and cooperating utility and manufacturing interests. Through J. T. Ward, vice-president, Boston Edison Co., an opportunity came to put on an exhibit at the New Ocean House, Swampscott, Mass., for the benefit of three groups of bankers (Federal, savings and cooperative) which met there in conventions in mid-September, thus bringing in concrete form to these sources of credit the latest ideas in relation to wiring as a vital necessity in building modernization and construction. The point was stressed that modern adequate wiring adds to the value of a house, and that banks will take the cost of such wiring into consideration when making mortgage loans. Many banks will also make repair loans for the purpose of installing adequate wiring in old houses. A closer tie-in with lending agencies resulted from this exhibit, which was well attended by delegates and others interested for a period of about ten days. Utilities cooperated in staffing the exhibit, men from Boston Edison, Lynn Gas & Electric, Cambridge Electric and Malden Electric (New England Power System) serving at the booth at various times during the conventions.

An adequate Wiring Committee of the Electric Institute of Boston, Inc., headed by J. H. Furber (Graybar Electric), is making active plans to push this interest. In connection with regular broadcasts from Station WEEI at 3:45 p.m. Monday to Friday inclusive by Irving T. MacDonald, news analyst, an opening announcement is given on the post-war importance of adequate wiring in the home, the limitations of insufficient wiring in relation to utilization of labor-saving devices in the household, and the value of suitable outlets and switching facilities, with references to the place of the local electrical contractor in realizing the advancement in facilities essential to modern living. At times the MacDonald broadcast is also followed by comments on wiring by Miss Emma Maurice Tighe, Boston Edison director of home service, who in a typical presentation stressed the need of suitable wiring and allied facilities to enable the postwar housewife to take advantage of the forthcoming improved lines of home appliances, lighting equipment and other electric products. Case records from unidentified customers on the system were reviewed to show the results of attempting to obtain satisfactory service from appliances under unfavorable conditions, as in families moving from well wired to poorly wired residences, with resort to extempore methods of service inside the home (two-way plug to plural appliances from the refrigerator outlet, etc.).

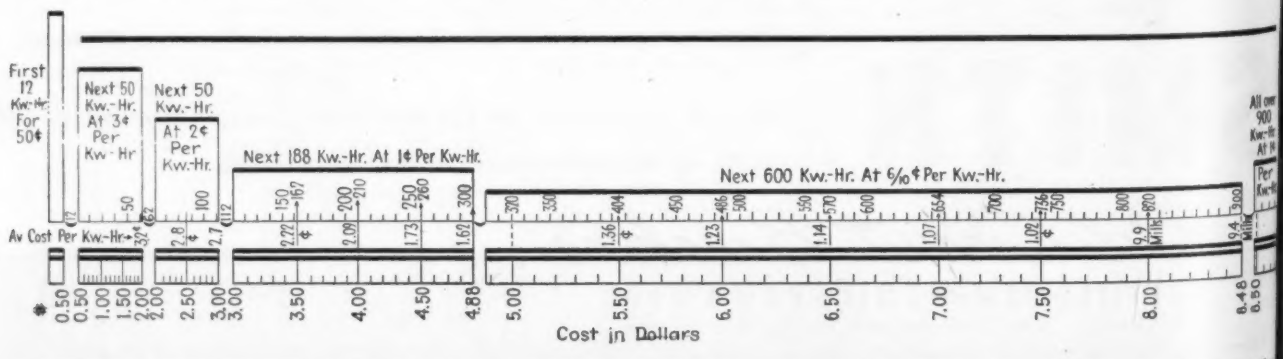
And finally, an indication of the rising popular interest in this subject appeared in Neal O'Hara's *Boston Traveler* column, "Take It From Me," which recently declared: "During the reconversion period and before electric appliances reach the retail markets in appreciable quantities, many electric companies, in conjunction with city and suburban banks, are stressing the need of having modernized home wiring done now—to be all ready for the new gadgets."

• • •

Novel Presentation of Residential Rate

A novel method of presenting its residential rate is used by The Washington Water Power Co. to make it easy for customers to understand the rate and to compute their own bills. The rate is set up in the form illustrated which combines three means of presentation. First, there is the usual printed statement of the schedule, then it is shown in block or step form and, thirdly, in the form of a scale. This scale also shows the several steps and in addition the bill for any number of kilowatt-hours may be read directly off—also the average rate per kw.-hr.

This graphical rate story is presented to customers in a number of ways, one of which is through salesmen in interesting a customer in a new appliance. With the aid of the rate chart the salesman demonstrates


First 12 Kw-Hr. For 50¢
Next 50 Kw.-Hr. At 3¢ Per Kw-Hr
Next 50 Kw.-Hr. At 2¢ Per Kw.-Hr.
Next 188 Kw.-Hr. At 1¢ Per Kw.-Hr.
Next 600 Kw.-Hr. At 5/10¢ Per Kw.-Hr.
All over 900 Kw-Hr At ¼
Per Kw-Hr
Av Cost Per Kw.-Hr
Cost in Dollars

DOMESTIC RATE SCHEDULE of The Washington Water Power Co. is given in easily understood form by graphical presentation

Now-Modernize with

PHILCO FLOTÉ STORAGE BATTERIES

For the expanded urban, rural and industrial power needs of the years ahead, Philco is ready with a selection of modern Control Batteries, engineered for this specialized service. These incorporate the advanced Philco Floté grid . . . a special development for full float service which eliminates low cells, reduces internal losses and adds greatly to battery life. Specify modern Philco Floté Control Batteries, in Steel Glass, Rubber or Vitrabloc jars. Write for new catalogs giving specifications.

Philco Floté Control Battery in armoured Steel Glass Jar.

PHILCO CORPORATION
Storage Battery Division, Trenton 7, New Jersey
Makers of the famous Philco "Thirty"

PHILCO

Famous for Quality the World Over

Philco invites you to tune in The Radio Hall of Fame, with Paul Whiteman and His Orchestra, Sundays, 6 P.M., EST.

FOR 50 YEARS A LEADER IN INDUSTRIAL STORAGE BATTERY DEVELOPMENT

Load-builder for your Darkest Hours

New midnight-to-morning load-builder—the G-E Automatic Blanket—*goes to work when your customers go to sleep.*

This "electrically-warm" Blanket builds up your load in the darkest hours. *Two* G-E Blankets equal one six-foot refrigerator in energy consumption and all off peak!

Newly efficient, newly lightweight and soft, these Blankets pioneered by G-E before the war, reappear as the impressive result of vast wartime research and use.

Tell your customers about the bliss of sleeping snugly warm under a soft, heated, single layer of blanket.

As a matter of fact, they may be around asking *you*. For they've been reading about G-E Blankets for months. In *Life*, *Good Housekeeping*, *House Beautiful*, *Harper's*, *This Week*, and *Atlantic Monthly*. They hear about the Blankets on the famous radio show, "The G-E House Party," too.

Write us today for suggestions as to how you can help build this load. General Electric Co., Appliance and Merchandise Dept., Bridgeport, Conn.

***FOR GOOD LISTENING:** Don't miss Art Linkletter, in "The G-E House Party," every afternoon, Monday through Friday, 4 p. m., E. S. T., CBS.*

Automatic Blanket

"Goes to work when the lights go out"

GENERAL ELECTRIC

on a blank form provided for the purpose how to figure the customer's present bill and how to figure the bill for an estimated additional number of kw.-hr. when some new appliance is added.

Rates and how their bills are figured no longer remain so much of a mystery to customers, and the important story of cheapness of electricity for home use has been effectively gotten over to the public.

•

Television Used as Sales Aid in Store

Gimbels of Philadelphia and the RCA Victor Division of Radio Corp. of America are now running in the Gimbel store an extensive demonstration of intra-store television specifically designed to show the power of video as a department store selling medium.

Using the practical theme, "Television Goes to Work," the store hopes to apply a yardstick to the selling assistance that television can provide by a dramatic presentation of the merchandise, and to measure the pulling power of television in building store traffic in selected selling areas. Based on the success of this demonstration, consideration will be given to the installation of television equipment in stores in Pittsburgh, New York, and Milwaukee.

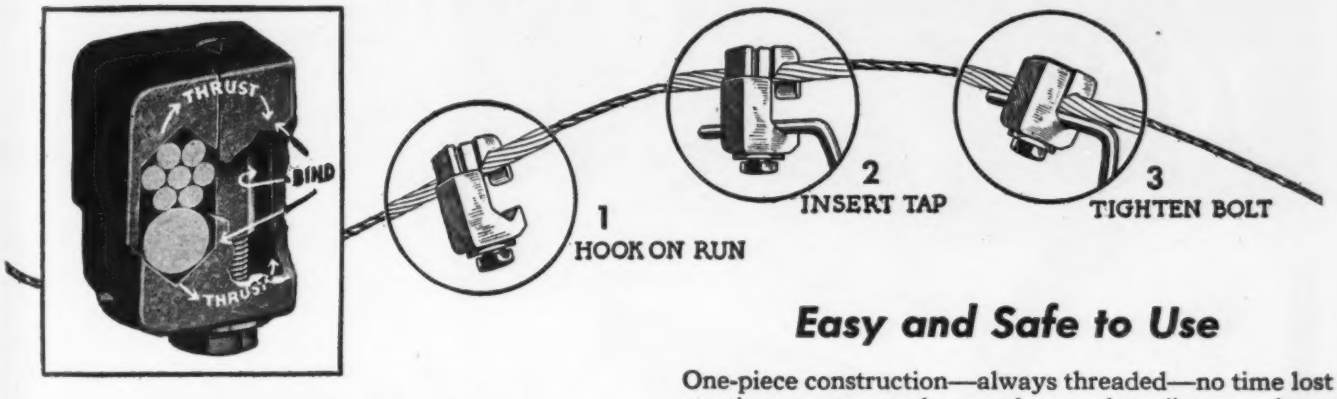
The demonstration, planned jointly by Gimbels and the RCA Victor Division, is the largest project of this type ever attempted. Viewing centers are installed on the seven floors of the store. Engineers are supervising the technical phases of the store-wide installation with the department store personnel handling the programming and merchandising aspects of the project. The National Broadcasting Co., RCA subsidiary, is cooperating by making available to the store members of its video production staff.

The store auditorium houses both studio and control facilities. An audience of about 500 people can see television production in action at each show. Shows are produced every half hour for ten minute periods with emphasis on dramatic presentations of the store's merchandise supplemented by entertainment features. RCA Victor has made available approximately 20 TRK receivers which have been in constant use since before the war and laboratory models of the new postwar

FARGO One-Piece Connectors

Easy to Use . . Grip Like a Vise

Save man hours . . . reduce service interruptions



"Grips Like a Vise"

High pressure at wire contact point develops tremendous *vibration-proof bind* from inside thrust against the vise-type sleeve of the body. The bolt, forged and rolled for extra strength, turns easily; develops 10 lbs. or more compression between conductors for every inch-pound of wrench pressure.

The mechanical construction of Fargo Connectors, plus the carefully selected copper alloys used (bodies 96% copper; high strength bolts 98% copper), insure high conductivity and dependability. They may be used over and over again.

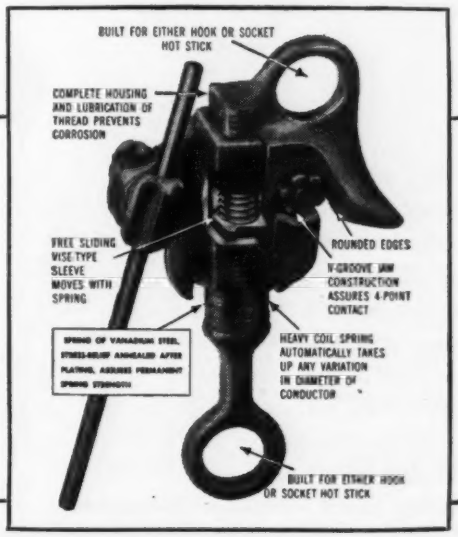
Easy and Safe to Use

One-piece construction—always threaded—no time lost starting a nut—no chance of cross threading—no loose parts to lose.

Safer to use. Bolt tightens with short, easy twist of the wrist; no arm or shoulder swing needed.

Three sizes of bolt heads—any adjustable wrench will fit 12 sizes of Fargo Connectors handling wires from No. 8 Solid to 6/0 Strand.

For full details of complete Fargo line see listing in current Electrical Buyers Reference.


BUILT FOR EITHER HOOK OR SOCKET HOT STICK
COMPLETE HOUSING AND LUBRICATION OF THREAD PREVENTS CORROSION
FREE SLIDING VISE-TYPE SLEEVE MOVES WITH SPRING
ROUNDED EDGES
V-GROOVE JAW CONSTRUCTION ASSURES 4-POINT CONTACT
HEAVY COIL SPRING AUTOMATICALLY TAKES UP ANY VARIATION IN DIAMETER OF CONDUCTOR
BUILT FOR EITHER HOOK OR SOCKET HOT STICK

New Fargo Hot Line Clamp prevents troubles due to loose contact arcing

The new A.G.E.-1 Fargo hot line clamp *stays tightly clamped.* A heavy coil spring working in conjunction with the vise-type body construction, exerts constant pressure which equalizes any differential between the expansion and contraction of the clamp and the conductor, caused by temperature changes, vibration, or the flowing of conductor metals. Thus, constantly firm contact prevents troubles such as arcing. The heavy coil spring is made of vanadium steel stress-relief annealed after plating to insure permanent spring strength.

Full Fargo line of Vise-type Connectors, Automatic Line Splices, Hot Line Taps and Sticks, Multiple Taps, Dead Ends, Compression Cone Connectors, Sleeves, Ground Clamps, and other Electrical Specialties are distributed by

LINE MATERIAL COMPANY · MILWAUKEE · WIS.

Representatives in principal cities

FARGO MFG. COMPANY ESTABLISHED 1914 POUGHKEEPSIE, N.Y.

QUIT
TAPING
TOOLS
SAFER
Dielectric Strength 1500 v/mil.
HANDIER
Thin Coat Conforms to Tool Shape
Improves Appearance
LONGER TOOL LIFE
MORE ECONOMICAL
Low Initial Cost. No Need to Renew.
For Safer Tools
INSL-X
#33
DON'T wait 'til it's too late! Don't wait 'til an accident reminds you that, at best — taping is an obsolete method of tool insulation. Whether you furnish your men insulated tools or whether each insulates his own — remember — the responsibility is yours. Be sure all electrical tools in your plant are safe. Be sure they're protected with INSL-X No. 33. The cost is extremely low—applied by us or in your plant. Write for information today!
FOR INSULATING BUS BARS
WE RECOMMEND INSL-X # 11
The Average Mechanic Needs It
The Superior Mechanic Deserves It
Literature Upon Request
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MEANS MODERN
INSULATION
THE INSL-X COMPANY INC.
857 MEEKER AVE., BROOKLYN 22, N. Y.
CHICAGO - DETROIT - LOS ANGELES - PHILADELPHIA - CLEVELAND - ST. LOUIS

large-screen projection receiver. They will be placed in advantageous positions throughout the store—the largest number of video receivers ever used in a department store demonstration. These viewing locations will be known as "telesites." Each floor has at least two "telesites" with four floors having three or more. More than 10,000 feet of cable, both coaxial and audio, were used in setting up this wide-spread store system.

•

Street Lighting Units Displayed by Utility

W. B. HURLEY
Staff Engineer, Sales Department
The Detroit Edison Co., Detroit, Mich.

Effective demonstration of modern traffic safety lighting equipment has been furthered with a novel display* developed by the Detroit Edison Co. Featured luminaires are mounted and wired so that they can be lighted to an agreeable intensity and swiveled to demonstrate their directional characteristics.

Originally used for the company's own sales people, engineers, construction and operating staff, the exhibit has more recently been circulating among the company sales offices where it is being displayed to customers and the public generally.

Five modern pendant luminaires featured in the display are supported by stanchions and a cross member above the display table on which are two older type upright luminaires and parts of modern equipment showing reflectors and deflectors. The illustration shows the arrangement.

Pendant luminaires displayed are, from left to right:

1. Combination reflector and refractor unit for residential streets, designed to redirect to the traveled way light that would normally shine on nearby residences.

2. A luminaire with reflector and deflectors that redirect light to the desired highway area. Used on relatively wide, main thoroughfares, it is designed for 10,000 and 15,000-lumen lamps.

3. A sodium vapor luminaire recommended for highway lighting and dangerous locations.

4. A combination reflector and deflector luminaire similar to No. 2 but for relatively narrow main thor-

* This display was mentioned in the article "The 'Look Ahead' of One Utility" appearing on pages 98-99 of the July 21, 1945, ELECTRICAL WORLD.

New ALL STEEL SCREW ANCHOR

DROP FORGED TRIPLEYE ROD
HIGH STRENGTH STEEL HEAVILY GALVANIZED
ROD and HELIX DOUBLE WELDED TOGETHER • SMALL HUB
HELIX CORRECTLY PITCHED and TAPERED

Easier to Install · · More Holding Power

Here is the latest improvement in the all-steel screw anchor—a drop forged steel tripleye rod, *double arc welded to a forged steel blade. This new anchor has been given "the works" in field and laboratory tests. It has topped our most optimistic expectations. Under ideal conditions, this anchor—in all sizes—has been tested to pull several times its rated holding power. We attribute its great strength to the fact that both anchor and rod are forged steel, *double welded together, with the blade being correctly pitched and tapered for minimum earth disturbance and the hub small to allow a greater holding surface.

The forged tripleye on the rod is large enough to admit a bar for use as a wrench in screwing down. It will accommodate one, two, or three guy strands. The SAE 1040 forged steel rod has a higher carbon content than other types of anchor rods and will not yield to torque during installation. Both rod and helix are heavily galvanized before the helix is dipped in asphaltum paint.

The pitch of this new anchor helix is not limited by the manufacturing process. By forming the rod and helix separately and welding them together, it is possible to control the pitch of the blade or helix, on every size anchor, to the exact degree required for best installation and holding power.

The steel blade or helix is tapered to the outer edge and sharpened to reduce friction and make installation easier. The small hub allows more holding area and minimizes earth disturbance, thus aiding installation.

Screw Anchors are made in 4, 6, 8, and 10 inch sizes and are recommended for installation in sandy soils.

**Blade is welded to rod on both top and bottom sides with shielded arc electric weld.*

A·B·CHANCE CO·
CENTRALIA, MISSOURI.

ABC INDUSTRIES

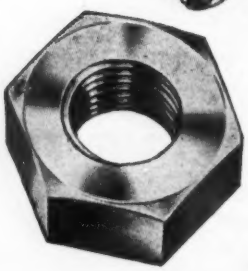
EVERLASTING

against the ravages of time

For countless ages, the Pyramids of Egypt have withstood the disintegrating forces of time and the elements. In comparison with the span of human life, the Pyramids are everlasting. In applications without number, Harper bolts, nuts and other fastenings resist rust, corrosion and other destructive conditions. Compared with assemblies they hold together . . . or with common steel bolts . . . Harper Fastenings are everlasting.

everlasting fastenings

Every Harper fastening is made of brass, bronze, copper, Monel metal, or stainless steel (none of common steel). Harper stocks include over 4360 items of bolts, nuts, screws, washers, rivets, nails, and special fastenings. New stock items are being continually added. Special fastenings made to order quickly from large stocks of metal in bars, rod, wire, sheet and other basic forms. Write for 104 page, 4 color catalog.



THE H. M. HARPER COMPANY

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Milwaukee • Cincinnati • Houston

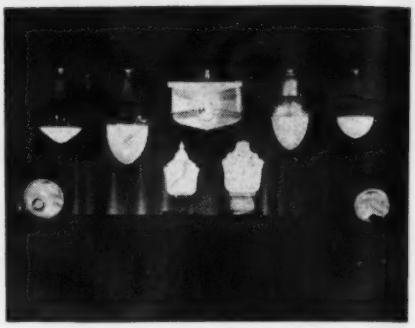
Representatives in Principal Cities

BRASS . BRONZE
COPPER . MONEL
STAINLESS

HARPER
Chicago

oughfares and a maximum of 10,000-lumen lamps.

5. A reflector-refractor luminaire for up to 10,000-lumen lamps. It has asymmetric distribution similar to the deflector unit, makes efficient use of light output.



BETTER STREET LIGHTING is being promoted by Detroit Edison with this novel display of modern traffic safety lighting equipment. Luminaires displayed can be lighted to agreeable brilliance and rotated to show directional features

The upright type luminaires displayed below direct too much light skyward and also since mounting height is usually low, tend to produce excessive glare.

Each display luminaire is connected to a fused switching panel that is connected to a 110/220-volt source by a cable and electric range plug. A transformer designed to operate a 6.6-amp. sodium vapor lamp from a 110-volt source is connected in the circuit between the sodium luminaire and the panel.

For demonstration purposes 6,000-lumen multiple lamps are used in all but the sodium vapor and the smaller upright unit where 10,000-and 1,000-lumen lamps respectively are used.

To demonstrate the redirective features of the pendant luminaires they are arranged to rotate a quarter turn.

Since the display has been "put on the road" some changes have been made in the original exhibit (shown) so that it could be more readily transported from place to place. The 7½-ft. stanchions have been hinged and hasped so that the top can be folded down. The table, originally 3½ ft. by 12 ft., has been narrowed to 2½ ft. and enclosed with Masonite, covered on top with black linoleum and provided with chromium-plated trim. Two signs, "Good Street Lighting—The Sign of a Good Place to Live," have been mounted on each side of the cross member. Enlarged photographs are mounted on Masonite enclosure.

ALL IN THE DAY'S WORK

A helicopter can easily hover low enough for pilot and passengers to talk with people on the ground nearby. The Kellett XR-8 helicopter, shown above, "stood still in the air" by the hour, at only *one foot altitude*, during its test period. When all was ready, restraining cables were loosed and its cross-country flying career began.

The XR-8 can fly forward, backward or sideways. It can rise or descend vertically, permitting take-offs and landings in any space large enough for safe clearance of its own blades.

Kellett has been active in the design of rotary wing aircraft—helicopters and autogiros—for over 16 years. More advanced models than the XR-8 are on Kellett drawingboards and in Kellett workshops today.

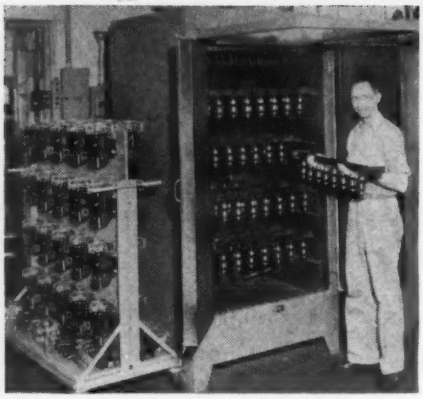
The final word in helicopter design will not be written for some time to come. Many engineering problems must be solved before helicopters are brought into practical daily use. Progress already achieved, however, more than justifies the manhours that must still be spent by Kellett and other organizations active in this field. Their objective is to make helicopters available for exacting travel and transport jobs, in areas and under conditions where no other air, land or water craft can operate.

Kellett Aircraft Corp., Upper Darby (Philadelphia), Pennsylvania.

KELLETT

NEW EQUIPMENT

Industrial Ovens



Model "RS" industrial ovens; sizes from 2x2x3 ft. to 4½x6x9 ft.; up to 500 deg. F. **Despatch Oven Co.**, Minneapolis 14, Ind.

Ovens are made for use in drying or baking processes up to 500 deg. F. Units are built in and are ready for cutting into the circuit. The ovens have a shelf arrangement which is said to result in easy loading and maximum use. Heating is automatically controlled.

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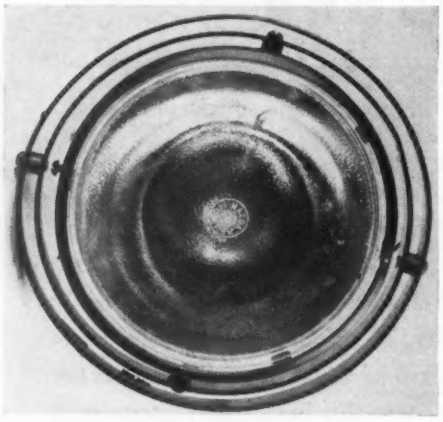
Spotlight Assembly



Lamp is held in three concentric rings, ⅝ in. deep and 4 ⅞, 5 7/16 and 6 in. in diameter. **General Electric Co.**, Nela Park Div., Cleveland, Ohio.

A method of mounting filament spotlights in fluorescent luminaires, which utilizes the familiar principle of the gimbal ring assembly of a ship's compass, makes possible a wide angle of adjustment for the projector lamps. It may also be employed in recessed individual wall or ceiling pockets. The outside ring is mounted in the fixture with thumb screws or bayonet locking device to permit easy removal. The inner ring supports the lamp and has two round bearing pins 180 deg. apart which fit into the intermediate ring. The intermediate ring also has similarly placed bearing pins that fit into the outer ring and these are located in the outer ring 90 deg. from the inner ring bearing which provides a two way, or universal, adjustment for the lamp.

•

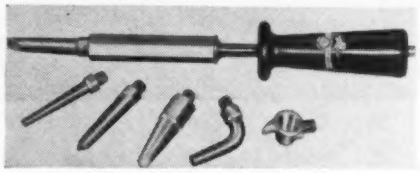
Conductivity Cell

Model "J" flow-type conductivity cell. **Industrial Instruments, Inc.**, 17 Pollock Ave., Jersey City 5, N. J.

Unit is enclosed in a hinged steel case and consists basically of a tubular glass cell with concentric cylindrical platinum electrodes and a continuous duty stainless steel centrifugal pump. Measurements are reported to be accurately made with rapidly changing concentrations.

•

Soldering Iron



Type No. 300 thermostatically controlled soldering iron: 225 watts; 110 to 125 volt a.c.; wt., approximately 14 oz.; length of iron, 13 in. **Sound Equipment Corp. of California**, 3901 San Fernando Rd., Glendale 4, Calif.

Iron comes equipped with six different style tips which are threaded for attachment to the nose. All of these are made of corrosion-resistant copper alloy except the tinning cup which is aluminum. The handle is made of molded plastic and the 6-ft. flexible cord terminates in a molded rubber plug. The iron is said to come up to heat in 90 seconds.

•

Wall Plate

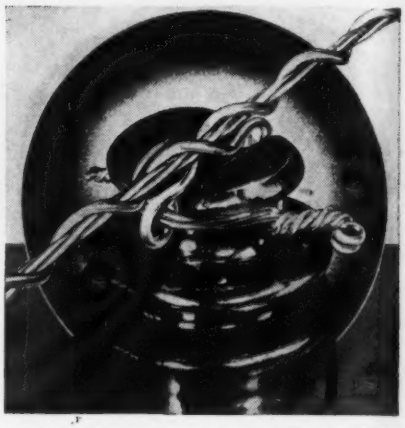
Aluminum wall plate for service entrance cable. **Thomas & Betts Co., Inc.**, 30 Butler St., Elizabeth 1, N. J.

A streamlined, solid formed aluminum wall plate for service entrance cable accommodates up to three strands of No. 4 wire. The unit has a hole in the bottom of the plate to allow for dripping or can be used to accommodate a ground wire up to No. 4 maximum. The plate is furnished with two wood mounting screws or with non-drying caulking compound for weatherproofing where desired.

BUYING ELECTRICAL EQUIPMENT?—McGraw-Hill's *Electrical Buyers Reference* is a convenient place to look first for manufacturers' product data, names and addresses.

•

Insulator Tie



Grip-Flex[45] insulator tie. **Copperweld Steel Co.**, Glassport, Pa.

The tie is completely preformed and is said to enable every lineman to do a uniform tying job because of the factory-formed parts. Three formed pieces make a top tie, four a side tie. It is reported to provide a "floating" support for the conductor since the reinforcing wire keeps the conductor away from the insulator. It is reported to comply with the National Electric Safety Code, to cut application time and to increase conductor life.

•

Ceramic Material

Material No. M-244: dielectric strength, 90 v. per mil; power factor 0.54 percent; dielectric constant (1,000 kc.) 5.30; coefficient of thermal expansion up to 600 deg. F. 1.6x10-6 and up to 1,000 deg. F. 1.9x10-6; modulus of rupture—5-in: span 9,200 and 2-in. span 11,500. **General Ceramics and Steatite Corp.** Keasbey, N. J.

Ceramic material is reported as suitable for use in high-temperature furnaces, insulation for high precision instruments in which the dimensional changes must be minimized, and for electrical and electronic purposes requiring low thermal expansion coefficient in ceramic parts. It is reported to withstand temperatures of 2,500 deg. F.

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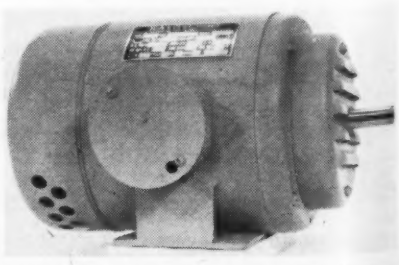
Motors



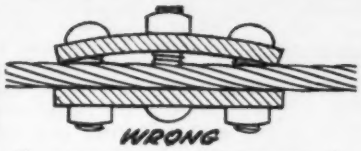
Model "DV07," d.c. motors: ¼, ⅓, ½ hp. sizes; for 110 and 220 volts, d.c. service. **Kato Engineering Co.**, Mankato, Minn.

Motors are of all steel construction; brush holders are of stamped brass with adjustable arms. The motor is said to be non-

WHY?

DO HUBBARD STRAIGHT GROOVE GUY CLAMPS HOLD BEST?

1. **Because:** The **straight groove** eliminates the possibility of drawing a nut tight against an "arched" section which is out of contact with the strand.



Clamping area reduced by warped section. Causes slippage at low strains.

Hubbard Clamps have full clamping area. Hold to breaking strength of most strands.

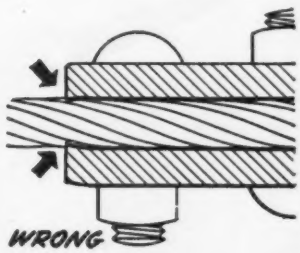
2. **Because:** The **straight groove** fits any and all twists, right or left hand and a variation in diameter without **creating** any high spots to **lessen clamping area.**

High spots in clamp reduce clamping area, cause slippage and injure strands.

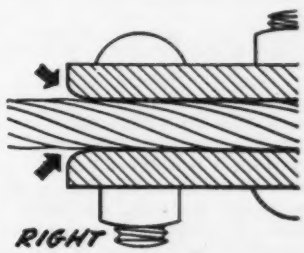
Hubbard Clamps fit snugly over any and all twists, right or left and variations of diameter.

3. **Because:** Bell-end grooves prevent injury to the strand.

4. **Because:** High carbon bolts prevent stripping or elongation. Heads are locked against turning while tightening—and the whole clamp is protected against corrosion by the best process commercially used — HUBBARD DOUBLE-DIP HOT GALVANIZING.



Sharp edge from sheared section injures and weakens the guy at end of clamp.



Rounded ends of Hubbard Clamp sections protect strand.

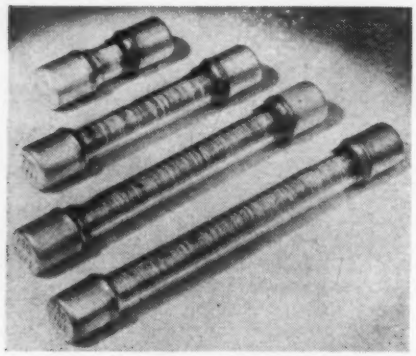
HUBBARD and COMPANY

Pittsburgh Oakland, Calif Chicago

radio interfering. Both louvered cover and commutator end cover can be rotated so as to permit mounting motor in any horizontal position and remain drip proof. The motor may be mounted vertically if desired.

•

Rectifiers



Selenium rectifier stacks: hermetically sealed; up to 4,000 volts. **Federal Telephone & Radio Corp.**, 200 Mount Pleasant Ave., Newark, N. J.

Selenium rectifier stacks are hermetically sealed-in-glass and are designed for high voltage usage. The stacks are constructed like a cartridge fuse and the electrical connection is made by silver plated ferrules at each end of the glass tube. These ferrules are of a size which permit mounting in 30-amp. fuse clips unpolarized or polarized by addition of a simple member to the fuse clip assembly. The rectifiers are available in several tube lengths for use on circuits up to 4,000 volts in high ambient temperature areas.

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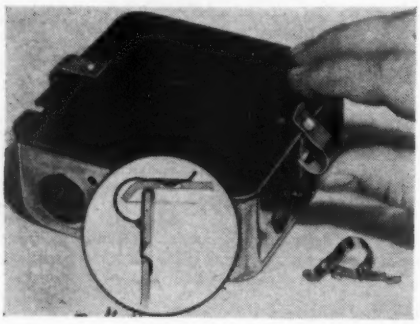
Cover Fastener



Spring steel box-cover fastener. **Tinnerman Products, Inc**, 2119 Fulton Rd., Cleveland 13, Ohio.

Spring steel fastener for box covers eliminates need for screws and nuts as well as tools for attaching. The clip is self-retaining since it is snapped into the prepunched holes in the box. By flipping the clip into the locked position, the cover is held in place. To remove the cover, the clips are unsnapped by pressure of the thumb. The clips are entirely outside the box and therefore do not come in contact with any wires or equipment within the box.

•

Switch

Renewable switch: up to 50 amp. at 110 volts, a-c. **Robert Hetherington & Sons, Inc.**, Sharon Hill, Pa.

The renewable switch is known as a plug-in type since it has two brass plugs which fit into the socket. The switch is furnished complete with plug and socket.

Alarm System

Alarm system with remote analyzer head: analyze combustible gases in any range from 0 to 100 percent; visible indication. **Davis Emergency Equipment Co.**, Inc., 45 Halleck St., Newark 4, N. J

An alarm system (which is said to detect the presence of combustible vapors, to give an audible signal at present conditions and to control appliances, such as shutting down machines, opening or closing ventilators, cut in fire prevention equipment or perform other functions) has a control cabinet which may be located at any distance in a gas-free area.

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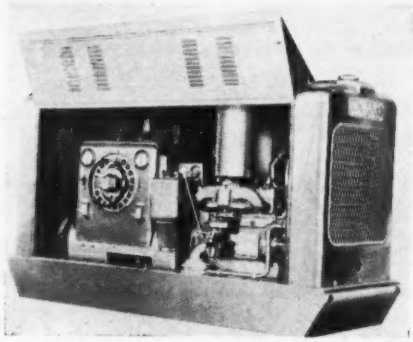
Welder



Engine-driven welder: range 40 to 275 amp. **Hobart Bros. Co.**, Hobart Square, Troy 1, Ohio.

Unit is completely enclosed in a steel housing and is powered by a 26-hp., 4-cylinder engine. It has a multi-range dual control wheel located on the generator control panel which makes possible 10 ranges of welding current and 100 steps of volt-ampere adjustment in each range. This makes possible 1,000 combinations of voltage and current for any desired arc characteristics. The control may be removed from the panel and located at the work and thereby eliminate trips between welding position and machine. Unit also has a mercury device which automatically idles the engine when desirable. Unit is available on skids and on a two-wheel pneumatic tired trailer.

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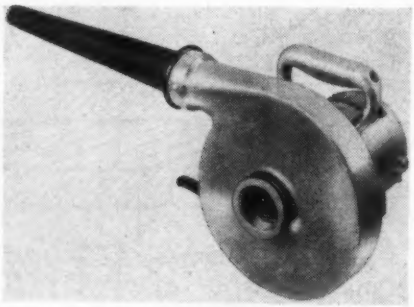
Blowers



Model "A" portable electric blower, ½ hp.; 2 speeds; for circuit voltages up to 275; 3-wire, rubber covered cord and grounded housing. **Ace Co.**, 12 N. Orange St., Ocala, Fla.

Unit is supplied with a rubber insulated nozzle for cleaning electrical machines and apparatus. It is reported to deliver 176 cu. ft. per min. and to develope 48 in. water column pressure on high speed; on low speed, 125 cu. ft. per min. and 26-in. water column pressure. Suction and spray equipment are available as attachments.

TECHNICAL LITERATURE

First Aid—A booklet, "Standing Orders for First-Aid Workers in Industry," is written for the safety engineer and first-aid workers' use after consultation with the company physician. Considerable space is devoted to discussion of supplies, records, physical arrangements of first-aid rooms, transportation of injured persons, and emergency procedures. Copies are available from American Mutual Liability Insurance Co., 142 Berkeley St., Boston 16, Mass., as long as the supply lasts.

Screw Data—Pocket size Library of Engineering Data on screws, drills and decimal equivalents is printed on four vari-colored cards. The set may be obtained by writing on company stationary to Manufacturers Screw Products, 272 W. Hubbard St., Chicago 10, Ill.

School Lighting — "School Classroom Lighting" bulletin No. 50-C contains a series of recommended lighting layouts to serve as a guide in solving lighting problems. It also contains photometric data which can be used in figuring foot-candle intensities when illustrated fixtures are utilized. Copies may be obtained from Daybrite Lighting Inc., 5411 Bulmer Ave., St. Louis 7, Mo.

Air Conditioning—Data folder, which contains a case history, shows how fuel, energy and equipment were saved. Also contains data on ventilation requirements and cost and comparison chart. Folder may be obtained from W. B. Connor Engineering Corp., 114 East 32nd St., New York 16, N. Y.

Street Lighting — "Hints on Lighting Maintenance" is a 24-page booklet which contains suggestions for planning a cleaning schedule, methods of cleaning and a list of suitable cleaning powders. Advantages of group replacement plans are discussed, and cost studies suggested for choosing between individual and group replacement. It includes curves which illustrate the effect of high and low voltage and current on life, lumen output efficiency of lamps, and recommendations are made for regulation. Copies of the booklet (No. B-3455) may be obtained from Westinghouse Electric Corp., Box 868, Pittsburgh 30, Pa.

Standards—Five tentative standards covering test methods for metal powders have been adopted. They are (1) No. 1-45T "Sampling Finished Lots of Metal Powders;" (2) No. 2-45T "Determination of Hydrogen Loss of Iron Powder," (3) No. 3-45T "Determination of Flow Rate of Metal Powders," (4) No. 4-45T "Determination of Apparent Density of Metal Powders," and (5) No. 5-45 "Sieve Analysis of Granular Metal Powders. Copies may be secured from Metal Powder Association, 420 Lexington Ave., New York 17, N. Y., at 10 cents per copy.

Insulating Materials — A folder which contains the electrical and mechanical properties of seven insulating materials is made up in handy reference form for both design and production engineer. Copies of the folder, Engineered Electrical Insulating Materials, may be obtained from Continental-Diamond Fibre Co., Newark 15, Del.

Home Freezers—Bulletin No. 34 entitled "Performance Characteristics of Commercial Home Freezers," by James R. Donnalley, Jr., is an engineering report on the insulation efficiency, power consumption and rate of freezing foods. Copies may be secured from Cornell University Engineering Experiment Station, Ithaca, N. Y., at 40 cents per copy.

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Illustrated is a DILECTO fabric base laminated phenolic part used in airborne electrical equipment. Since this part is subject to severe mechanical stresses and is also an insulator it must be strong and remain stable under vibration, high humidity and temperature extremes. DILECTO meets all these requirements, with a wide margin of safety.

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Bulletin GF gives Comprehensive Data on all C-D Products. Individual Catalogs are also Available.

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NEWS ABOUT PEOPLE

Dr. Rettaliata Directs I.I.T. Mechanical Engineering

Dr. J. T. Rettaliata, formerly manager of research and gas turbine development for Allis-Chalmers Mfg. Co., recently assumed new duties as chairman of the mechanical engineering department at Illinois Institute of Technology.

J. T. Rettaliata

Recognized as one of the nation's outstanding young mechanical engineers, Dr. Rettaliata received his B.E. from Johns Hopkins University in 1932 and his doctor of engineering degree from the same school in 1936.

While engaged in graduate work, Dr. Rettaliata served as an instructor in mathematics and later as head of the mathematics department and instructor in engineering at the Baltimore College Center.

He took charge of the calculation and development division of Allis-Chalmers' steam turbine department in 1936, later being appointed manager of the research and gas turbine development division. During the summer of 1940, Dr. Rettaliata obtained a leave of absence from Allis-Chalmers to accept a fellowship from the National Academy of Science for a report on special applications of gas turbines.

Dr. Rettaliata was awarded the junior award of the American Society of Mechanical Engineers for his paper on the "Combustion Gas Turbine" in 1941 and the following year he received the highest award obtainable by a young mechanical engineer, the Pi Tau Sigma Gold Medal Award, for outstanding achievement in mechanical engineering.

In the latter part of 1943, Dr. Rettaliata was sent to England on a special mission involving jet propulsion aircraft. He returned this summer from a second mission on which he spent some time in Germany investigating enemy technical developments.

Dr. Rettaliata has recently been appointed a member of the newly-created subcommittee on turbines which has been established under the Committee of Power Plants for Aircraft of the National Advisory Committee for Aeronautics.

•

Combustion Assigns New Sales Duties to Hatfield

Robert M. Hatfield has resigned as deputy vice-chairman of the War Production Board to become assistant general sales manager of Combustion Engineering Co.

R. M. Hatfield

Mr. Hatfield became identified with Combustion Engineering Co. in 1934 as a student engineer, subsequently serving in the service and erection department, the proposition department and then as sales engineer in the Cleveland Office. In 1942 he went to Washington as chief of the boiler section of the power branch, WPB, under J. E. Krug and later became director of the production scheduling division.

He resigned from WPB in 1944 to accept a commission in the Navy, and in November of that year was assigned back to WPB to take charge of the Navy repair parts program. Last April he was placed on inactive status by the Navy to become deputy vice-chairman for production of WPB, the position he held until the War Production Board was abolished early this month.

•

Fairbanks, Morse Elects Morse III Vice-President

Charles H. Morse III has been elected vice-president of Fairbanks, Morse & Co., with headquarters in Chicago. Mr. Morse will be in charge of research patents, traffic, the company's western pump division and the Inland Utilities Co., Fairbanks-Morse subsidiary.

C. H. Morse III

Immediately after receiving his discharge following two years of service in World War I, Mr. Morse entered the company's Three Rivers, Mich., plant as a factory worker. Then followed intensive training in various departments of the company that ranged from factory man up to his present position.

In 1935 Mr. Morse was elected president of the Inland Utilities Co. Since then he also served for a brief period as assistant general manager of the company's Beloit Works.

•

► CLINTON R. HANNA, associate director of the research laboratories of the Westinghouse Electric Corp., was made the recipient of the degree of doctor of engineering by Purdue University, his Alma Mater, at recent commencement exercises in Lafayette. Mr. Hanna won a Presidential citation in 1942 for his work in the development of the

BURKE solves synth

THE PROBLEM . . .

To furnish an electric motor and suitable control to replace a 300 H 1200 RPM, Synchronous Motor, driving a banbury mixer, for the purpos of obtaining adjustable speed over a wide range. This banbury wa originally installed to process crude rubber, and in changing over to th use of synthetic rubber, it was found that batch after batch of rubber an materials were burned up during the mixing process. Experiment an research proved that a slower mixing speed was required, or even better a range of speeds of about 4 to 1, so that the mixing process could b started at slow speed and completed at high speed.

rubber processing problem

THE SOLUTION . . .

AFTER a preliminary survey of the problem, it was thought the solution was simply a matter of applying a 300 HP adjustable speed, tapered HP direct current motor, having a speed range of 400 to 1200 RPM by field control. Further study revealed, however, that sufficient direct current power was not available for this type of driving motor.

It was here that Burke Engineers suggested that as long as continuous speed adjustment from low speed to high speed was not of prime importance, a 4 speed squirrel cage induction motor would be ideal for the application. Burke Engineers recommended the purchase of a 300 HP, 1200/900/600/450 RPM, 2300 volt, 4 speed, 2 winding, constant torque, squirrel cage induction motor, having high pull out torque for overcoming the sharp peak loads, and complete with a fully magnetic, across-the-line type starter. The selection of a 4 speed, squirrel cage, induction motor and control effected a considerable saving in initial cost over the direct current motor and control, eliminated the necessity of increasing the direct current generating capacity of the plant and above all still satisfactorily solved the perplexing problem.

The selection of a 4 speed squirrel cage induction motor, as a driving means for the banbury mixer introduced another problem not common to the direct current driving motor, and that problem was finding suitable control equipment to automatically accelerate and decelerate the motor while operating under full load, without causing serious disturbance to the power system, or imposing severe mechanical strain on the motor.

The standard listed control equipment available on the market did not provide the desired characteristics so, Burke, in conjunction with the Electric Controller Manufacturing Company, of Cleveland, Ohio, worked out a special fully magnetic controller, built around frequency sensitive relays, instead of time delay relays, to provide the automatic acceleration and deceleration. The varying frequency power to operate the relays of the starter being obtained from a frequency generator, directly connected to the main motor, so that its output frequency varied directly as the speed of the main motor. Each relay being adjusted to operate at a frequency corresponding to a certain motor speed. This controller is operated from a five position master station, mounted on the banbury mixer, convenient to the operator. The control functions so that irrespective of the speed selected by the operator, the motor always starts across-the-line on the low speed winding and accelerates progressively to the speed desired. If 1200 RPM is selected, the motor starts on the 450 RPM winding and accelerates to 440 RPM, at which point a frequency relay operates to energize the contactors connecting the 600 RPM winding to the line. As the motor speed reaches 590 RPM another frequency relay operates to energize the contactors connecting the 900 RPM winding to the line. When the motor reaches 890 RPM, still another frequency relay operates, energizing the contactors connecting the 1200 RPM high speed winding to the line. In this way the motor starts with a minimum of starting current and accelerates smoothly to the selected speed, with the least possible delay and with the transfer from one speed to another being made at exactly the proper instant to minimize the mechanical shock to the motor and disturbance to the power system.

In decelerating, or changing from a higher to a lower speed winding, it is extremely important to eliminate entirely the possibility of the power being thrown on the lower speed winding before the motor has decelerated to the speed selected. The complicating factor in deceleration cycle, was the fact that the time of deceleration varied considerably, depending on the magnitude of the load of the motor and the lower speed selected, so that a time delay relay for controlling the deceleration operation would be entirely out of the question. In changing from a higher to a lower speed winding, for example, from 1200 RPM to 450 RPM this being the extreme case, the operator would move the master switch from the high position to low position and the motor would be disconnected from the line and allowed to decelerate. Then, when the speed of the motor dropped to 450 RPM, a frequency relay would operate, energizing the contactors supplying power to the 450 RPM winding. In this way the motor would be thrown on the line again at exactly synchronous speed, eliminating any possibility of connection above synchronous speed, causing severe regenerative effects, or connection below synchronous speed, causing high current peaks in pulling the motor up to speed again.

Send your special motor or generator problem to . . . Burke Engineers . . . Write for Burke general catalog.

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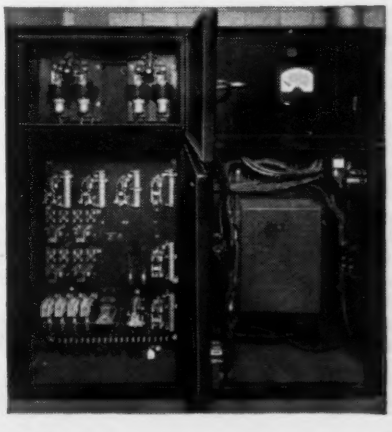
1511 West 12th Street
ERIE, PENNSYLVANIA



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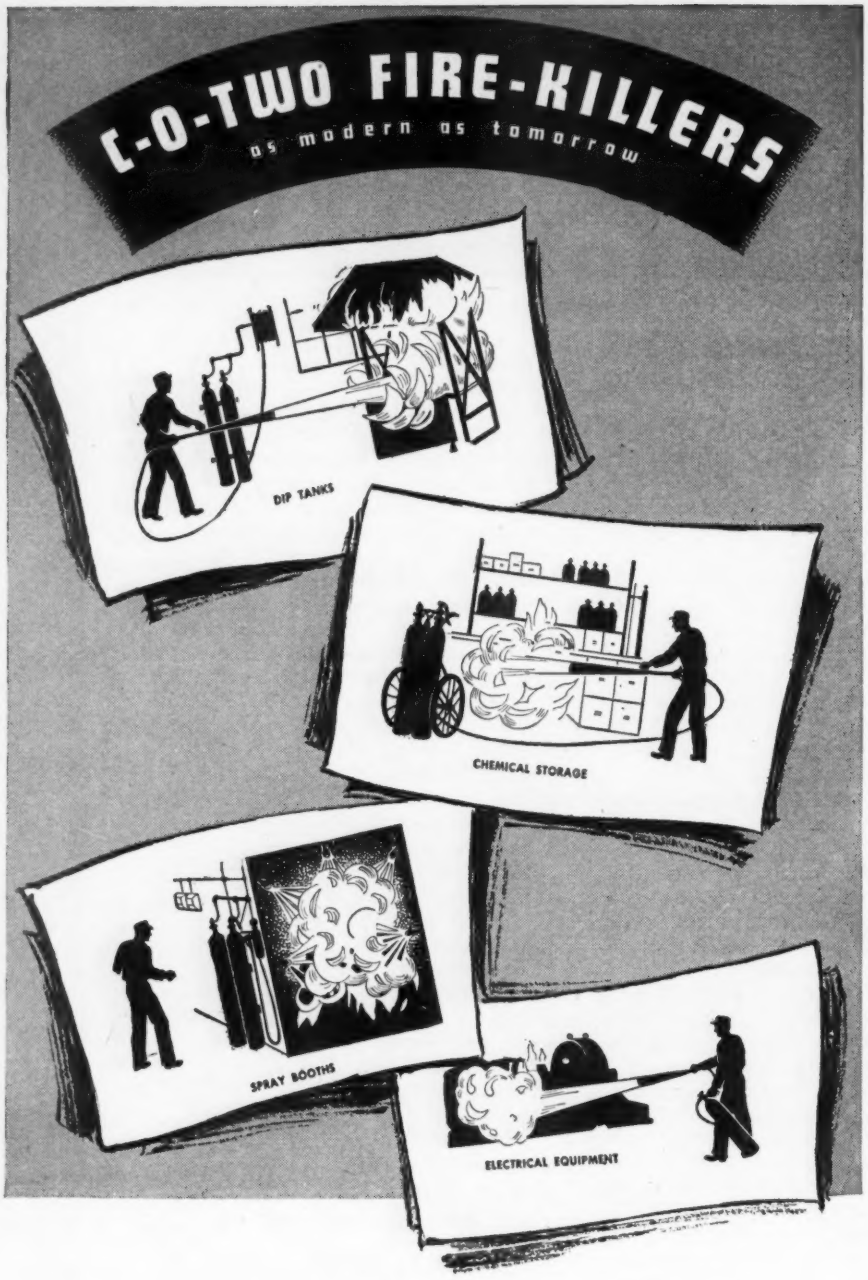

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NEWARK 1 NEW JERSEY
Sales and Service in the Principal Cities of United States and Canada
AFFILIATED WITH PYRENE MANUFACTURING COMPANY

tank-gun stabilizer. He has been associated with Westinghouse for the past 23 years, engaging in and directing advanced development work on new apparatus, and has inventions covered by more than 90 patents in the United States and other countries. Mr. Hanna is a fellow of the American Institute of Electrical Engineers.

•

Apex Electrical Makes Engineering Appointments

Several appointments in the engineering department of the Apex Electrical Manufacturing Co., Cleveland, have been announced by C. G. Frantz, president.

Don W. Randolph has returned to his pre-war position of director of engineering after military service.

Ralph E. Kortepeter, formerly director of commercial products, becomes chief engineer of the company's Cleveland plant and Archibald H. Davis, formerly in charge of Cleveland plant engineering, was named chief engineer of the Holland-Rieger Division plant at Sandusky.

The new appointments, Mr. Frantz stated, are a part of the company's program of expanding its research and engineering activities to many times their pre-war level.

•

▶ LAURENCE A. DUNN has been appointed merchandise manager of the United Illuminating Co., New Haven and Bridgeport, Conn., succeeding BYRON B. SPINNEY, who has resigned to enter the appliance distribution field. Mr. Dunn was merchandise manager of the company's New Haven division until 1942, when he became general storekeeper.

▶ J. P. H. PERRY, vice-president of the Turner Construction Co., New York, has been elected president of United Engineering Trustees, Inc., succeeding F. M. Farmer, vice-president and consulting engineer, Electrical Testing Laboratories, New York.

▶ WALTER HEREN has been appointed advertising manager for the Union Electric Co. of Missouri, succeeding the late W. K. Holland. Mr. Heren joined the company about five years ago as assistant secretary after 20 years of newspaper and public relations work in Kansas City and vicinity.

▶ JAMES L. CASTERLINE has been appointed superintendent of the Saluda hydro-electric project on Lake Murray, S. C., owned and operated by the South Carolina Electric & Gas Co. He succeeds the late J. T. Steppe, who had been superintendent of the Saluda plant

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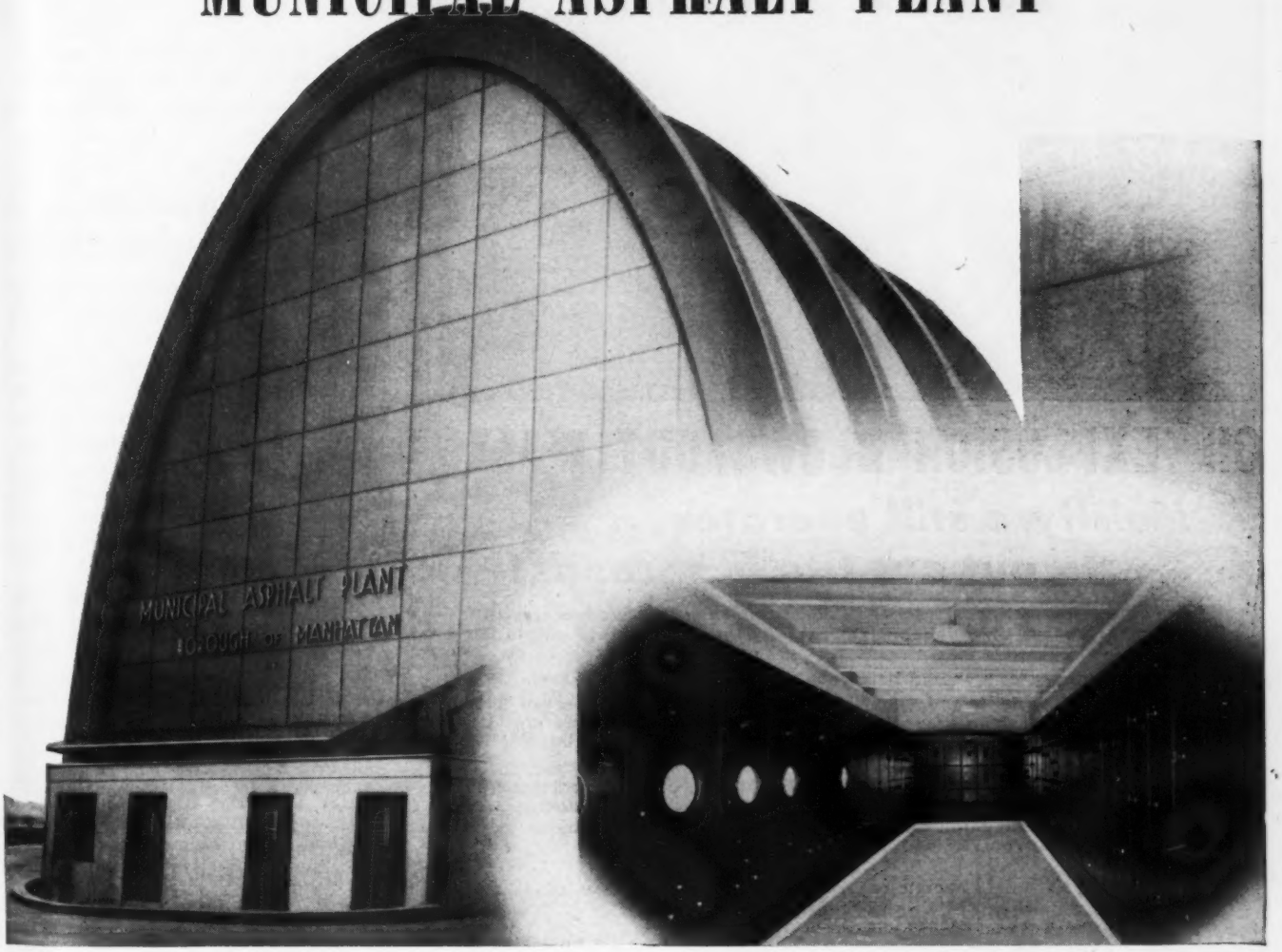

At the right are listed various types of electrical control equipment designed and furnished by METROPOLITAN for utilities, industrial plants, large mercantile establishments, and public buildings. Your inquiries are invited.

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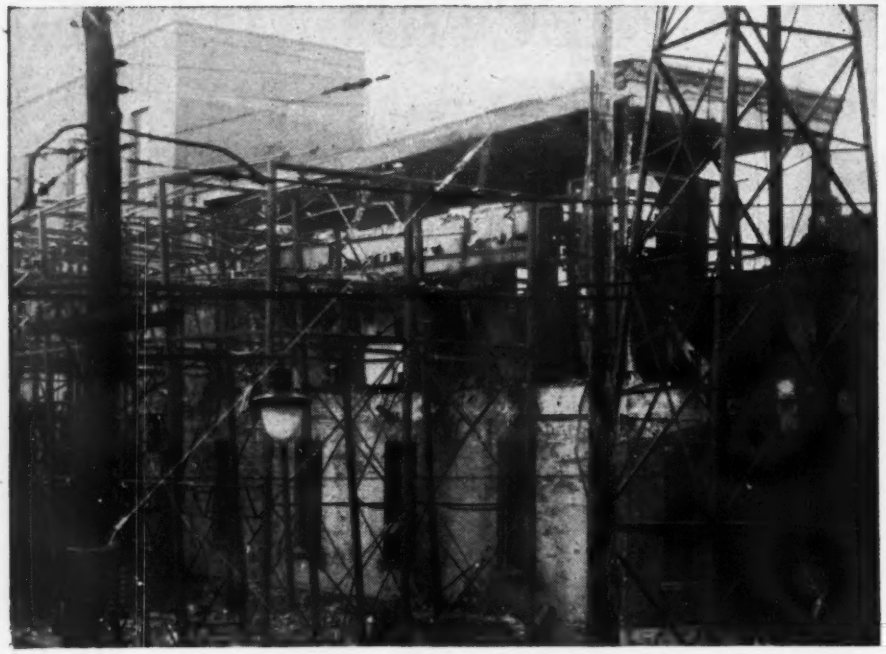


OIL EXPLOSION BLOWS OUT WALLS

Mulsifyre still operates... to put out fire in seconds!

"Fire duration a matter of seconds . . . equipment soon restored to service." This was the report of a leading power company on a recent substation explosion!

Severe electrical storm caused line troubles which repeatedly operated the circuit breakers. 45 gallons of oil was expelled from two of them in a fine, highly volatile spray which combined with the air in the room to give an explosive mixture. This mixture was ignited by the flame coming out of the tanks through the explosion vents.

The *instantaneous action* of the 29 Grinnell MULSIFYRE Projectors extinguished the resulting fire . . . saved valuable electrical equipment. Burning oil from this switch room, if not immediately extinguished, could easily have flowed down into the transformer room below.

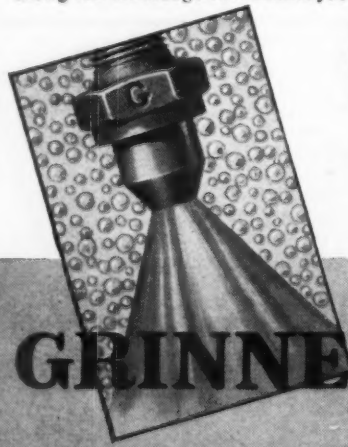
MULSIFYRE SYSTEMS operate on the principle of emulsifying blazing oil with a driving spray of water. The oil is turned into a liquid which is incapable of burning. Fire is extinguished in a few seconds and reignition is prevented.

Complete separation of water and oil takes place in a few hours . . . leaves oil undamaged.

There is absolutely no conductivity along the discharge of a Mulsifyre projector when spray strikes conductors carrying high voltages.

Mulsifyre Systems are permanently installed . . . they operate automatically or manually.

Recommended by Underwriters' Laboratories for use in extinguishing fires in flammable oils immiscible with water, wherever such oil is a fire hazard – in transformers and other oil-filled electrical equipment.



See that your equipment has this 24-hour-a-day protection, *before* fire strikes. Experienced Grinnell engineers will help you plan protection for your specific needs.

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GRINNELL *Mulsifyre*

AUTOMATIC FIRE PROTECTION

since it began operation in 1929. Mr. Casterline joined the old Columbia Railway Gas & Electric Co., predecessor to the present utility, as a master mechanic at the Parr Shoals hydro-electric plant. In 1930 he transferred to the Saluda property as mechanical supervisor, the position he has filled since that time.

▶I. L. ILLING, illuminating engineer, Wisconsin Electric Power Co., Milwaukee, has been made assistant sales manager.

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New Assignments Made by General Electric

Among the appointments announced recently by the General Electric Co. are the following:

LEWIS J. MALE, assistant general superintendent of the Schenectady Works, has been appointed general superintendent, succeeding BERNHARD G. TANG, whose retirement in September concluded more than 45 years of service with the company. Mr. Male has been connected with the G-E since 1913 and Mr. Tang since 1898.

GEORGE CARLSON has been made design engineer for the conduit products division of the company with headquarters in Bridgeport. Mr. Carlson was formerly assistant design engineer for the wire, cable and conduit section. RALPH C. DEAN has been appointed sales manager of the conduit products division, appliance and merchandise department. Mr. Dean has been connected with G-E since 1930.

J. M. LANG has been appointed manager of the Ken-Rad Division of the electronics department with headquarters at Owensboro, Ky. In this capacity, Mr. Lang will be in charge of the operations of G-E Ken-Rad plants in Owensboro, Ky., and Huntingburg, Ind., and will also be responsible for the management of government-owned G-E tube plants at Bowling Green, Ky., and Tell City, Ind. Mr. Lang succeeds C. J. HOLLATZ, who will make his services available in a consulting and advisory capacity for the present. Since last January, Mr. Lang has been assistant manager of the Ken-Rad division.

FRANCIS M. FALGE has returned to General Electric at Nela Park in the capacity of lamp sales specialist, after serving in the Navy since 1941. He will be in charge of G-E lamp department's new installations of large and miniature lamps throughout the country. Mr. Falge joined G-E at Nela Park in 1926 and subsequently became G-E district engineer at Los Angeles.

Appointments of CLAYTON P. DUNNING as manager of the newly-organized

New York appliance sales district and of CARLETON A. REEVES as manager of the northeastern appliance sales district, Boston, have been announced.

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▶HERSCHEL F. JONES, formerly assistant to the director of the Office of War Utilities, has been appointed to the staff of the Bonneville Power Administration. Mr. Jones will be special assistant to Barclay J. Sickler, chief of Bonneville's division of power sales and service, and will be responsible for preparation of coordinated power load estimates for use in development of the Bonneville Power Administration's immediate and long-range construction programs and in over-all Columbia basin development studies. He brings to the Northwest a broad background of experience including special studies on defense aspects of the St. Lawrence Seaway project conducted for the Department of Commerce, research on integration of United States power resources under a fellowship from the Social Science Research Council of New York, and research on the Nebraska power industry for the Works Progress Administration and the University of Nebraska.

▶J. D. EBY, manager of purchases of the Wagner Electric Corp., St. Louis, has been elected to the secretaryship of the company, filling the vacancy created by the death of J. W. Westcott. Mr. Eby has been identified with the Wagner organization since 1906. In addition to managing the company's huge wartime purchases, Mr. Eby participated in many war activities. He served various governmental agencies concerned with priorities and material controls, and was an automotive industry advisor to WPB, and Washington chairman of the Material Control Committee of the Automotive Council for War Production. During 1942 he served on one of the committees of the National Electrical Manufacturers Association dealing with war production.

▶E. U. LASSEN has been appointed assistant chief engineer of Cutler-Hammer, Inc., Milwaukee, Wis. A native of Norway and a graduate of the Federal Institute of Technology, Zurich, Switzerland, Mr. Lassen came to the United States in 1924 and joined the Cutler-Hammer organization as a draftsman. Later he transferred to the company's engineering department as a designing engineer and in 1930 was made an engineer supervisor. In this capacity, among his responsibilities were the following divisions of the company's business: oil field control, welding and electronic control, drum type controllers, power plant control apparatus, ship propulsion and submarine con-

They share the load
AUTOMATICALLY . . . WITHOUT ATTENTION
Assuring an adequate and uninterrupted supply of direct current (for control bus, circuit breaker and emergency loads) . . . automatically and without manual attention . . . DEMANDS the "teaming together" of only the most dependable Batteries and Full-Automatic Chargers. That the "Diverter-Pole" Charger ranks at the top of the list is supported by thousands of installations made in the past 30 years . . . PROOF that the "Diverter-Pole":
★ ASSURES MAXIMUM BATTERY LIFE . . . Only the constant voltage method of charging protects the battery against over-charging during the Floating-Charge period. Analyze Zone 1.
★ SHARES LOADS WITH BATTERY . . . Its "constant-voltage" characteristic permits the "Diverter-Pole" Charger to carry all loads within its safe capacity. The change to a "constant-current" characteristic (Zone 2) shifts automatically dangerous overloads to the "team-mate" battery operating in Zone 3 . . . thereby protecting itself against harmful overloads.
★ GIVES FULL-AUTOMATIC OPERATION . . . Increasing use of "Diverter-Poles" in isolated automatic and supervisory-controlled substations is convincing evidence that this type of charger needs only infrequent inspection. Its voltage automatically remains constant despite fluctuations in load or a-c power supply.
CHARGER
BATTERY
CHARGER VOLTAGE
BATTERY VOLTAGE
VOLTAGE RISE HERE ASSURES STABILITY
105 VOLTS (Minimum Battery)
ZONE 1
CHARGER HANDLES ALL LOADS IN ZONES 1 & 2
ZONE 2
TRANSITION AREA
ZONE 3
BATTERY HANDLES ALL LOADS IN ZONE 3
This Curve is for a machine designed to Float 60-Cell Batteries at 2.15 Volts per Cell
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VOLTS
125
100
75
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An extremely hard board of superior quality which can replace the more expensive types of insulating materials.

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trol, railroad propulsion control and variable voltage control systems. Mr. Lassen is a member of the American Institute of Electrical Engineers, and has just been named as chairman of the newly formed industrial control devices committee of that society. He has also served on various technical committees sponsored by the National Electrical Manufacturers Association. During World War II he was active in committee work sponsored by the Navy Department in the program to bring Navy general specifications for electrical control equipment up-to-date.

▶ J. HENRY HODDE, secretary and a director of the Sangamo Electric Co., Springfield, Ill., recently retired after 43 years of continuous service with the company. Mr. Hodde joined Sangamo in 1902. He had a major part in development of the company's mercury motor meters and was closely associated with the late R. C. Lanphier, developing several other products which the company now manufactures. For many years he was superintendent of department 28, where final assembly and testing of all products are made. He became secretary in 1934.

▶ R. W. MEULLIER, electrical engineer for the city of Fort Lauderdale, Fla., for ten years, has resigned.

▶ DON W. RENNEWANZ has been appointed sales manager of the range division, Edison General Electric Appliance Co., Chicago. Mr. Rennewanz has been a range and water heater specialist in the Seattle, Wash., sales district.

▶ E. D. WACKER has been appointed general manager of the C. J. Tagliabue Division (Brooklyn, N. Y.) of the Portable Products Corp. For the past eight years, Mr. Wacker has been general sales manager and associated with C. J. Tagliabue for a period of 22 years.

▶ HAROLD D. CONKLIN has been appointed manager of the appliances division of the Admiral Corp., Chicago. Mr. Conklin joined Admiral in 1944 as manager of the electric range division.

▶ NORMAN H. SAUNDERS has been appointed engineering manager of the Kellogg Switchboard & Supply Co., Chicago, succeeding R. M. KALB, chief engineer, resigned. Mr. Saunders assumes full charge of all research, development, design and general engineering of Kellogg products. He has just retired from the Army, where he served as a colonel in the Army Signal Corps.

▶ THOMAS P. CUSACK, JR., has been appointed director of sales development for the C. M. Hall Lamp Co., Detroit. Previously, Mr. Cusack had been head of the company's infrared division. He

joined the C. M. Hall Lamp Co. staff in 1940 as a radiant heating engineer. In his new position, he will give impetus to a greatly expanded program for developing and marketing lighting equipment in the aviation, marine, industrial and domestic fields. The infrared division will continue under his guidance.

▶ PAUL H. MERRIMAN, for eight years head of the electrical group, tool engineering, The Glenn L. Martin Co., Baltimore, Md., has assumed new duties as head of the electrical and electronics section of the laboratories of the Martin organization. Mr. Merriman became identified with Martin 12 years ago.

▶ HARRY SOHON, formerly assistant professor of electrical engineering, Moore School of Electrical Engineering, University of Pennsylvania, has been appointed advanced-development engineer with the Radio Corp. of America, Camden, N. J.

▶ JAMES H. RASMUSSEN, formerly general sales manager of the manufacturing division of the Crosley Corp., Cincinnati, is now a vice-president of the United Wall Paper Co. of Chicago.

OBITUARY

Robert E. Barrett

Robert E. Barrett, 64, president and treasurer of the Holyoke (Mass.) Water Power Co. for the past 25 years, died at a hospital in Springfield, Mass., on October 13. He was born in Framingham, Mass., and was graduated from Harvard in 1905. In his early career he was engaged in engineering construction at Boston, Mass., in connection with the Charles River Basin and the Commonwealth Pier, later being associated with the Catskill Water Supply System in New York. In 1913 he was named designing engineer for the directors of the Port of Boston, and in 1917 became construction engineer for the Turners Falls Power & Electric Co., in Massachusetts, now a part of the Western Massachusetts Electric System.

Under his leadership the Holyoke Water Power Co. has developed on a substantial scale along both steam and hydroelectric lines, its expansion including modernization and installation of generating facilities and many other improvements in the service which began generations ago with mechanical water power applications to local industries.

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▶ PETER L. PETERSON, 63, for 35 years superintendent of maintenance for the New England Power Co., until his retirement in 1942, died at his home in Worcester, Mass., on October 27. He was a native of Finland, and was identified with the development of the com-

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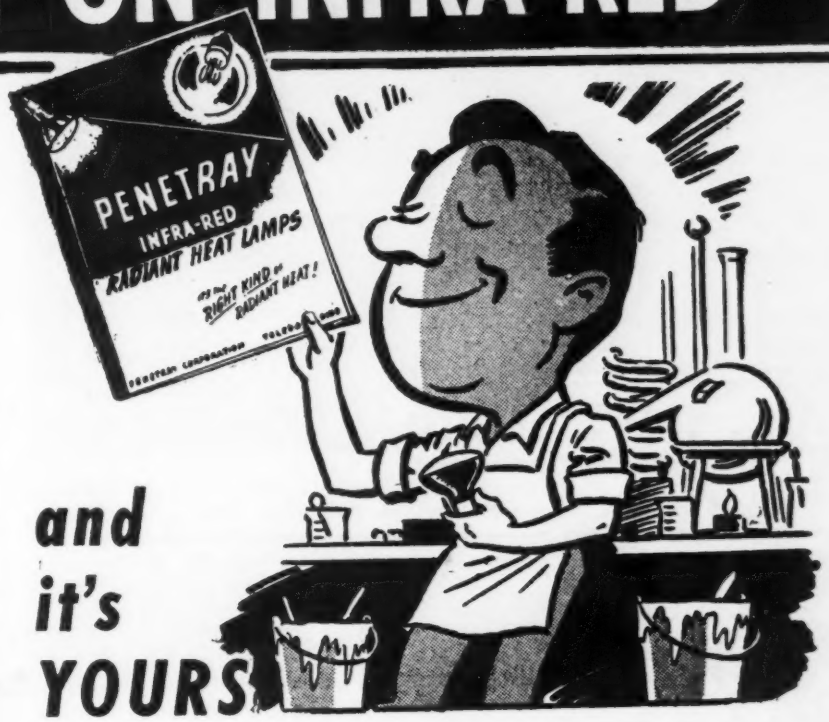

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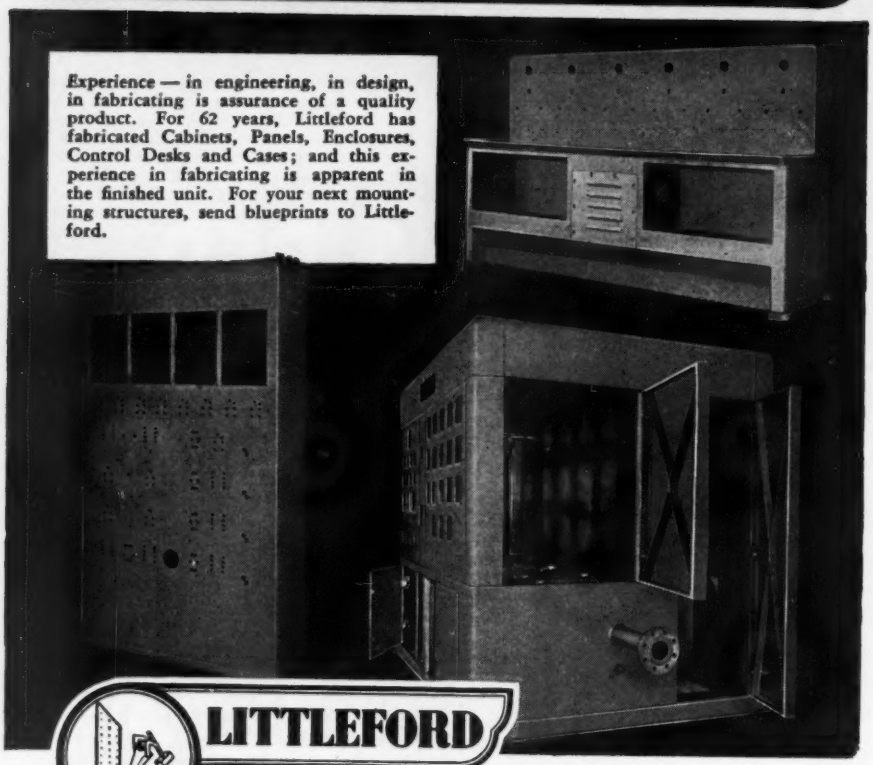

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#24 in a series of informative letters from a producer of Power Switching Equipment

The products manufactured by Royal embrace the complete line of Power Switching Equipment

An important part of such equipment is the necessary bus supports for outdoor and indoor service. The outdoor combinations using either cap and pin or post insulators are shown on pages 123 to 128 of our catalog.* The indoor units are described on pages 241 and 242.

Our engineering facilities are always available for the design of special applications.

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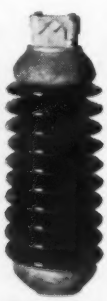
Type VHN
34.5 kv.



Type NP
34.5 kv.

Heavy Duty
Indoor Combination

ROYAL ELECTRIC MFG. CO. 619 E. 40th Street CHICAGO 15, ILL.

pany's system from its earliest operation of plants and lines in the central Connecticut Valley and Worcester County areas. His headquarters were at Worcester.

•

Frank A. Newton

Frank A. Newton, nationally known as an authority on utility rates and valuation and for many years in general supervisory charge of rates for the Commonwealth & Southern Corp. system, died on November 16 of a heart attack in Peoria, Ill.

Mr. Newton was born in Sparta, Wis., in 1884 and after attending the college of engineering at the University of Wisconsin spent some time in Colorado with the U. S. Reclamation Service and the U. S. Geological Service. Subsequently he was engaged by the Wisconsin Railroad Commission.

In 1912 he joined the staff of Hodenpyl Hardy & Co. in connection with public utility rate and valuation matters and when the Commonwealth & Southern Corp. was formed in 1929 he was placed in general supervisory charge of rates for that system.

Mr. Newton had been chairman of the Rate Research Committee of the Edison Electric Institute for a number of years and was a frequent contributor to technical and trade publications on matters pertaining to rate and valuation.

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▶ GEORGE A. PHILBROOK, 75, for the past 40 years superintendent and manager of the Middleboro (Mass.) Electric Light Department, with which he became connected as a steam plant engineer 51 years ago, died suddenly in that town on November 10. He was born in Woburn, Mass., and entered the employ of General Electric at Lynn, Mass., as a boy in his early teens. He spent a year as a steam plant operator in Providence, R. I., and returned to General Electric for a few years until he went to Middleboro, where he built a high reputation as an operating manager. Last year Mr. Philbrook's semicentennial with the department was celebrated at Middleboro in the presence of representatives of the electrical industry from many parts of eastern New England. Legislative provision for his retirement contingent upon action by the town in 1946 had recently been made.

▶ JAMES B. CAMPBELL, supervisor of street lighting sales for the Cleveland Electric Illuminating Co., died suddenly on November 11 in Cleveland at the age of 54. Mr. Campbell had been identified with the Cleveland utility for more than 25 years.

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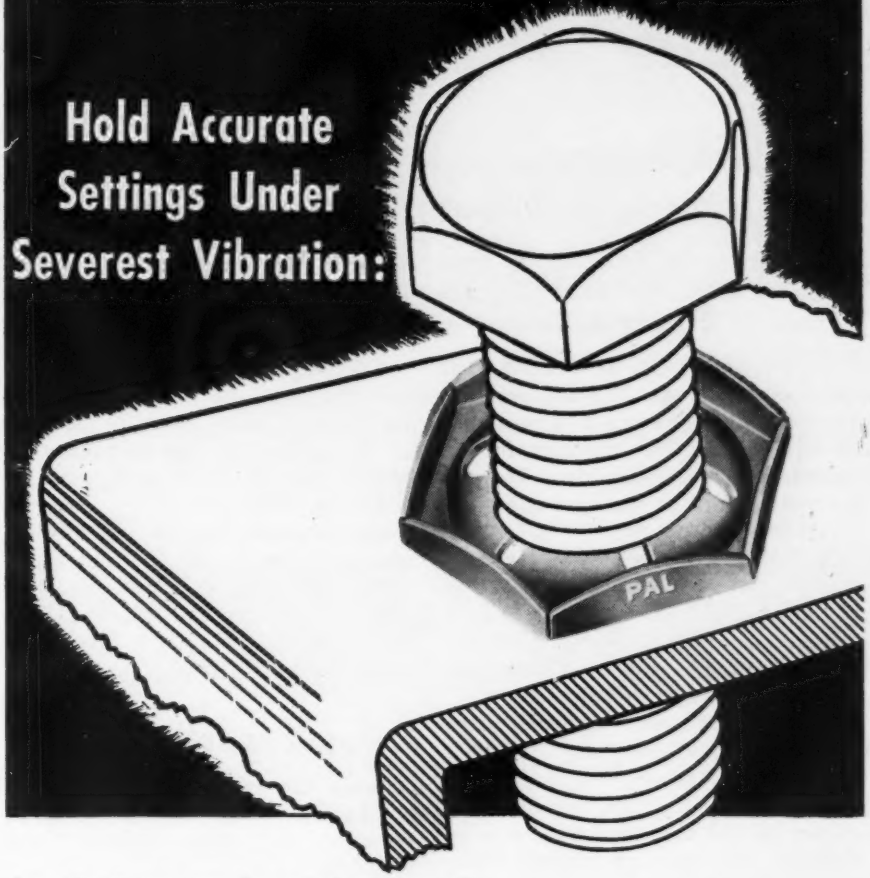

An adjusting screw that won't "stay put", is soon valueless. To maintain accurate settings of adjusting screws, lock them with Palnuts instead of regular hex nuts or jam nuts. This provides a powerful double-locking action* that is unmoved by severe, prolonged vibration.

Single thread, tempered spring steel Palnuts require only 3 bolt threads space. They spin on fast with fingers, lock tight with ¼ to 1/3 turn of wrench. Cost not more, and frequently less, than regular nuts; may be re-used. Full line of sizes in National Coarse and National Fine Threads.

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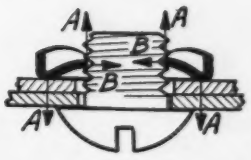

***Double Locking Action**

When the Palnut is tightened, its arched slotted jaws grip the bolt like a chuck (B-B), while spring tension is exerted upward on the bolt thread and downward on the part (AA), securely locking both.

DOUBLE-LOCKING PALNUTS

MANUFACTURING MARKETS

Group of Employees Acquires Cochrane

Company to Be Managed by Men Long Associated with Organization—T. E. McBride Heads

Announcement has been made that the Cochrane Corp. of Philadelphia has been acquired by a group of men long associated with the company in the engineering and sales divisions. The new corporation will be managed and operated by its owners.

T. E. McBride was elected president and the following men named as vice-presidents: C. E. Joos, apparatus division; V. A. Rohlin, Works Manager, A. E. Kittredge, chief engineer, and E. S. Daugherty, heater division.

The board of directors includes H. E. Sibson, for many years the company's general sales manager, and W. V. Sauter of Philadelphia. There will be no change in the Cochrane line or sales policies. An aggressive program of development and research is now being planned.

Mr. McBride, the new president, was vice-president and treasurer of the American Engineering Co., Philadelphia, before he headed the group which acquired Cochrane Corp., of which he has become president, treasurer and general manager. Earlier connections included Arthur Andersen & Co., Chicago; Lyon and Healy, Inc., Chicago, and the Republic Drill & Tool Co., Chicago.

Mr. Rohlin, vice-president and works manager, entered the employ of the Cochrane Corp. in 1913, became chief engineer in 1929, and works manager in 1937.

Mr. Joos, vice-president, apparatus division, became identified with the Cochrane Corp. about 20 years ago as salesman in the water conditioning division, and has managed this division of sales for ten years. He has been instrumental in the development of equipment and methods now in general use in steam power plants in other fields.

Mr. Kittredge, vice-president, engineering, was employed in the turbine engineering department of Westinghouse and later by Brown Boveri before entering the employ of Cochrane about 1925 as an engineer. He became chief engineer in 1937, and has been completely responsible for the design and engineering of all products handled by the company since that time.

The new vice-president and secretary, E. S. Daugherty, became associated with the Cochrane Corp. about 23 years ago as an engineer in the instrument division, engaging in the design and research on fluid flow meters. He continued in engineering on heat transfer, metering, control and treating equipment until 1936, when he entered the apparatus sales division. Mr. Daugherty has occupied the position of manager of heater sales since 1937.

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Noma Buys Triumph Stock

Noma Electric Corp. has acquired 97 percent of the stock of Triumph Industries, Inc., Henri Sadacca, Noma president, has announced.

Westinghouse Enters Home Heating Field

Entry of the Westinghouse Electric Corp. into the field of electric heating for homes, an entirely new activity for the company nationally, has been announced by H. F. Boe, vice-president in charge of the district manufacturing and repair department of the company. Manufacturing headquarters will be located at Emeryville, Calif.

Under terms of a license granted by the Wesix Electric Heater Co., San Francisco, Westinghouse has acquired the right to use the basic principles involved in the design, construction and control of unit type electric heaters, according to a joint announcement made by Mr. Boe and W. Wesley Hicks, president of the Wesix organization.

Volume production of a complete line of newly styled models is expected to get under way soon in the Westinghouse plant at Emeryville, where a large area is being made ready. Stuart L. Forsyth, formerly of Pittsburgh, will head the new activity as sales manager for the company's new home heating section.

•

Forms Distributor Firm

Formation of York Distributors, Inc., a wholly-owned subsidiary, has been anounced by S. E. Lauer, president of York Corp. The new company will provide complete sales, installation and services for York commercial air-conditioning and refrigeration equipment. W. A. Pusch has been named president

TO SEE AND REPORT—D. Hayes Murphy, president of Wiremold Co., Hartford, Conn., shows the members of the press who recently toured Connecticut that the facilities are ready, while John D. Murphy, company vice-president, (extreme left) reveals that several new workers will be needed at this bench. It was pointed out that the company employment rolls are 40 percent longer than at the time of Pearl Harbor

and treasurer of the new corporation. Other officers are R. C. Follett, vice-president and sales manager, and John F. Lebor, secretary.

•

Baker Synthetics, Inc. Formed in New York

Announcement has been made of the formation of Baker Synthetics, Inc., with offices in New York, by Henry F. Baker, president. The new organization will manufacture Corrosite and other plastic products.

H. F. Baker

Associated with Mr. Baker in this undertaking are George S. Cooper of New Canaan, Conn., a former executive vice-president of Diamond Alkali, and H. Kelsey Wallace, an officer of the Chase National Bank.

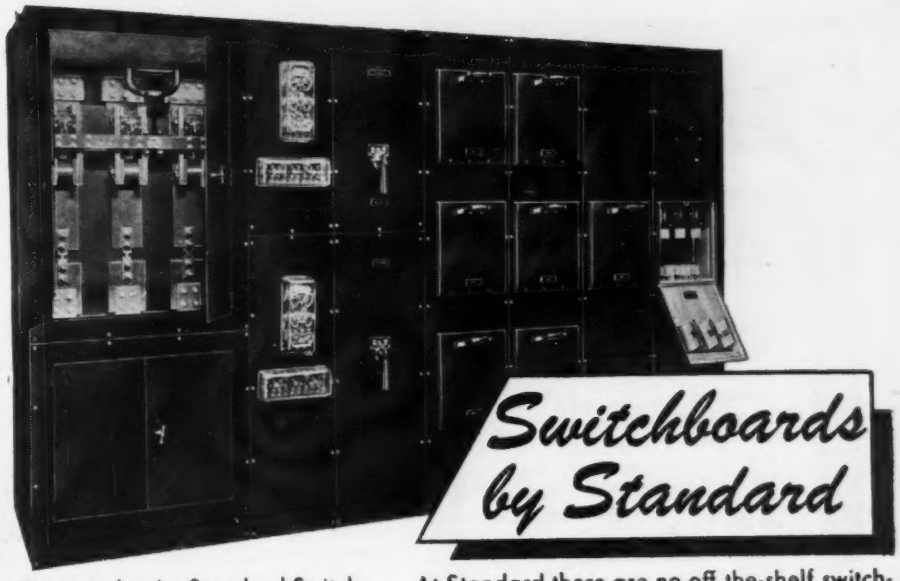
Plant and laboratory facilities of Baker Synthetics, Inc., have been established at Ravenna, Ohio.

•

Technical War Secrets Will Be Released by Wallace

The Department of Commerce has been designated to make available to American industry and science the various war secrets of scientific and technical data secured from the Germans and other enemy sources. This is in addition to its service as a source of scientific and technical knowledge developed through government sponsored research that may be applicable to industrial reconversion and contribute to the economic well-being of the country.

Secretary Wallace has created within the Commerce Department the Office of Publication Board, which already has started work in close cooperation with the War and Navy Departments, the Office of Scientific Research and Development, the National Advisory Council for Aeronautics and other government agencies.



Switchboards by Standard

Illustrated is the Standard Switchboard, *Service and Distribution Switchgear*, designed and custom built to meet the particular requirements of one of this country's largest manufacturers of drugs and pharmaceuticals.

At Standard there are no off-the-shelf switchboards. Every panelboard and switchboard is specially designed and incorporates the knowledge and experience gained by many years service to hundreds of switchboard users.

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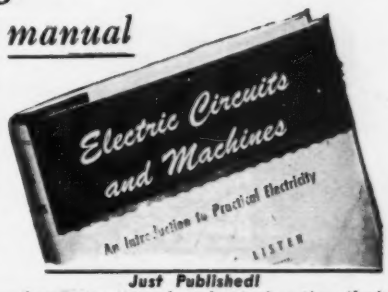
For a quick, sure knowledge of electric circuits and machines

through a single, practical manual

- **both direct and alternating current**
- **minimum of mathematical explanation**



This expertly-written manual supplies you with a clear, concise description of the broad field of both direct and alternating current electric circuits and machines between the covers of a single volume. It does this with as few mathematical explanations and analogies as possible, using only simple algebra when necessary.

Just Published!

Here is a practical manual for the professional man—demonstrating the physical action that takes place, rather than analyzing the theory behind it. It will help you to master all of the vital elements of modern electrical usage.

ELECTRIC CIRCUITS AND MACHINES

An Introduction to Practical Electricity

By EUGENE C. LISTER

Electrical Engineer, Stanley Engineering Co.; Formerly Supervisor of Electrical Theory Instruction, Specialized Training Program, Iowa State College.

358 *pages*, 5¼ *x* 8¼, 233 *figures*, $3.50

This book is a completely practical, highly instructive manual which will guide you through the intricacies of circuits, batteries, magnetism, induction, generators, various kinds of motors and controls, transformers, alternators, electrical instruments and electronic tubes more simply and easily than you ever thought possible. It has been written for the man who needs a good overall understanding of the field, yet doesn't want to spend hours poring over involved theory. Text material is illustrated with hundreds of figures and diagrams—the appendix supplies you with handy wiring diagram symbols and a number of helpful tables.

Check over these topics:

- Construction of the Edison cell
- Factors affecting the amount of induced emf
- Generator action of a motor
- Automatic control of D-C motors
- Transformer construction
- The repulsion-start induction motor
- Electronic tube elements
- The grid-controlled gas-filled tube

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Field Reports on Business

Industrial production is being maintained well above the comparable period in 1939. Shortages in certain lines of material are still a factor in the reconversion picture. Schools are becoming prominent in the lighting and wiring fields, with more adequate facilities being planned in various sections.

PACIFIC COAST

More adequate wiring for state schools is to be recommended by an industry committee on the basis that present practice provides little margin for inevitable expansion of demand. The prevailing standard for indirect school lighting is 30-foot candles, but wiring for 40 incandescent and 80 fluorescent is proposed. This wiring question is timely because school construction is a major building item and will become increasingly so with such recent successful bond issues as $994,000 for Santa Ana and $2,500,000 for Stockton. Moreover, Oakland has voted $15,432,000 for new schools and re-equipment of existing plant, including overhaul of lighting systems.

San Francisco voted 5 to 1 for a proposed $20,000,000 enlargement of the municipal airport.

Prospective orders include three 2,500 kva. and one 4,000 kva. transformers for Bonneville, Westinghouse having low bid at $82,978; a low bid of $404,320 for clearing 71 miles of right-of-way for Arlington-Blaine leg of Bonneville network; $40,000 of extensions, feeders, and appurtenances for Anaheim's municipal plant and $89,753 G-E transformers for El Centro system in Imperial Valley.

Reclamation Service will add a 5,000-kw. generating plant, costing $900,000 near Shoshone Dam in northern Wyoming as part of Heart Mountain project.

Ford is active along coast, with a parts and distributing plant, costing $775,000, planned for Seattle, a $700,000 award for a parts building in Denver, and a site being sought near Maywood, L.A. County, for an assembly plant costing approximately $3,000,000.

NEW ENGLAND

Plans are well advanced for important industrial expansion in Massachusetts and Connecticut and some construction is already underway. Power and factory lighting equipment sales are promising. A $1,000,000 plant will soon be begun for Manning, Maxwell & Moore at Watertown, Mass. Bendix Helicopter, Inc., is planning a factory at Stratford, Conn., which will have 150,000 sq.ft. of floor area available for production.

Electrical specialties in cooking and hotel service are attracting more attention. Howard Johnson Co., Boston, has completed plans for the erection of a restaurant at Post Office Square in the Boston financial district; and Terrace Club Hotel, being built in Middleton, R. I., will be equipped throughout with services for broadcasting and television programs.

Allotments for post-war planning authorized by the FWA last week amounted to $42,000 for projects estimated to reach a total cost of about $1,250,000. Electric pumping, control apparatus, and wiring supplies for sewage disposal plants, schools and libraries are included in these appropriations. An order for 50,500 ft. of light and power cable was received recently by Collyer Insulated Wire Co., Pawtucket, and others for thermocouples aggregating $5,000 to Lewis Engineering Co., Naugatuck, Conn. Sales of machine tool bearings in fair sized lots, and spare parts ordered from Connecticut aircraft manufacturers show the present trend in size and diversity of government buying in this area.

Bendix Aviation Corp. reports active production on a large volume of orders for marine equipment for the Navy at its Norwood, Mass., plant. Oil burner installations in Boston are increasing at a fast rate. Lighting supplies for the coming holidays are beginning to appear in the electrical market in small and restricted lots.

CHICAGO

Although contractors are busy with reconversion electrical work, and good wiring men are scarce, the future—after reconversion—appears doubtful, because of the lack of activity in the residential construction field. Since construction workers have advanced on an average only about 8 percent in wages since 1929, the cause of this inactivity is not attributed by local authorities to building labor, but is regarded as a condition created primarily by obsolete rent ceilings, and secondarily by uncertain material costs and rising maintenance costs. These factors combine to make new building unprofitable. The result is that both ownership and loan capital are being withheld from the field.

Wholesalers find it difficult to obtain certain materials in adequate quantities for current electrical installations. Although the overall level of stock on hand is high, the supply of needed items is unbalanced, and consequently many items must be carefully rationed. Malleable castings, conduit, wiring devices are tight at this time.

The demand for fluorescent fixtures is much greater than the supply, due chiefly to the inability of sheet-steel manufacturers to make deliveries in less than six to seven months.

Borg-Warner's Norge division has added electrically-powered portable water coolers to its line of products; also home and farm freezers in four sizes ranging from 6 to 26 cubic feet in volume; and an automatic cycle washer that can be installed in the average kitchen.

NEW YORK

Though industrial output showed little change last week from the previous week, production is being maintained well above the comparable period in 1939. Shipments, generally, continue behind schedule.

Civil engineering volume in continental United States totaled $76,318,000 last week, this volume being 67 percent higher than the preceding week's and 159 percent higher than the corresponding week last year, according to *Engineering News-Record*. Private construction, continuing to climb, was 84 percent greater than the preceding week's volume and 840 percent greater than the corresponding week last year. The week's construction brought the 1945 cumulative volume to $1,945,634,000 for the 46-week period, a 23 percent gain over the similar period of 1944.

Cooler weather brought stronger consumer demand for seasonal apparel. Department store sales in the Metropolitan area were estimated as running about 20 percent ahead of the similar week last year.

Recent Rate Changes

QUEENS BOROUGH GAS & ELECTRIC CO. has reduced electric rates to customers $381,000 annually, effective November 1, according to an announcement by Milo R. Maltbie, chairman of the New York Public Service Commission. All consumers will benefit from the revisions and the savings in monthly bills will range from 6.3 to 15.7 percent. A rate proceeding instituted by the commission prior to the company's offer to make a reduction will be closed, it was said at the officers of the commission. Of the total amount of the reduction, approximately $239,000 will accrue to the benefit of the residential and religious customers. Small business and commercial users will receive a reduction of approximately $110,000 annually. An amount of $19,700 will be saved by the public through the discontinuance of connection charges, and various communities in the company's territory will receive a reduction of $12,000 annually in street and highway lighting bills.

CONSOLIDATED EDISON CO.'s new and reduced rates for electricity applicable to residential users and religious institutions (ELECTRICAL WORLD, November 10, Page 206) were approved by the New York Public Service Commission immediately after filing by Consolidated. The new rates will result in an estimated reduction of $2,560,000 a year for consumers in the classifications named.

DERBY GAS & ELECTRIC CO. has been authorized by the Connecticut Public Utilities Commission to reduce electric rates for customers in Ansonia, Derby and Shelton. The change will aggregate savings to customers of $45,000. The new plan is a result of hearings held October 24 and replaces a plan instituted December 13, 1943, through which refunds or credits were made to customers totaling $15,000 a month. Termination of the war and a substantial decrease in revenues caused the company to discontinue the accrual of the monthly credit October 31. The new rate will give commercial customers an annual savings of $30,000 and domestic customers $15,000 from the old rates.

PLAIN CITY (OHIO) BOARD OF PUBLIC AFFAIRS has ordered a 25 percent reduction in light rates for consumers of the municipal power plant, estimated to save more than $19,000 a year to consumers.

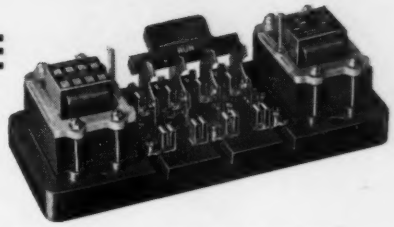
CITY OF LOUISVILLE (KY.) lost a plea to the Kentucky Public Service Commission for temporary reductions in electric rates of the Louisville Gas & Electric Co., while the city's main $3,400,000 rate reduction request remains pending. Ruled "not germane to the case" was a motion by the city that the utility show cause why its residential electric rates should not be reduced at once to par with Tennessee Valley Authority schedules. A second motion to show cause on rate reductions was filed, omitting reference to the TVA rates, and it likewise was denied consideration. Chairman Thomas B. McGregor said the commission already had before it the company's motion for a dismissal of the city's original rate reduction case or for "an interlocutory order or finding of opinion." He told counsel for the city: "We'd like to get that out of the way."

PRINCE WILLIAM COUNTY ELECTRIC COOPERATIVE, which has its generating plant and headquarters in Manassas, Va., has announced reduced rates for rural residential service. The old rate of $3 for the first 25 kw.-hr. per month is now $2, with other rates scaled down proportionately.

TESCO

PHASEFORMER

Assures ACCURATE Measurement of power factor!



Here is a simple, quick method for accurately measuring reactive power.

The Tesco Phaseformer is mounted on a molded base of insulating material. Leads are protected against injury . . . the phasing transformers are liberally designed to supply ample capacity for the burden of the potential coils . . . the watt loss is low.

Overall dimensions of the Tesco Phaseformer are 11" long—4½" wide x 3 13/16" high. Slots are provided in the base for the connection wires in the front connected model.

Write today for more information on the Tesco Phaseformer. Ask for bulletin #23.

TESCO FEATURES

1. No loose wires
2. Coils readily replaced
3. Cover cannot be replaced unless switch is in running position
4. Watts capacity insures correct ratio and phase angle under load.

The Eastern Specialty Company

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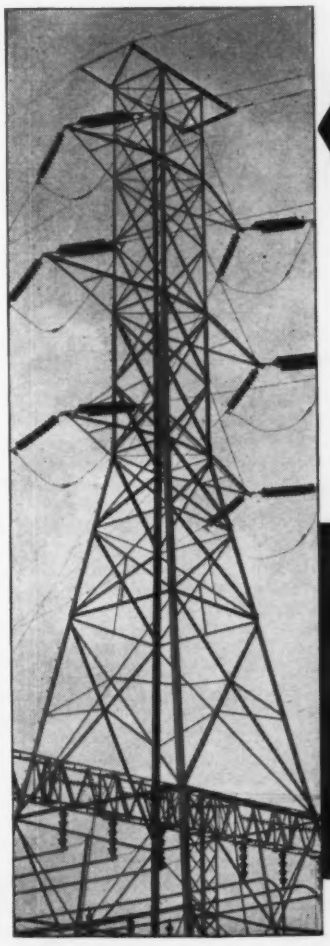

DILLON DYNAMOMETER

A multitude of Dillon Dynamometers are protecting communities and companies alike from failures caused by wires going down in severe storms. Standard for dependable accuracy, simplicity and convenience. Actual size 8¼" x 6¼" x 3". In wide use also in telephone and telegraph work for indication of tension in guy strands, messenger and wire. Many other uses where torque, weight, and overload are vital factors. Take out guesswork of "sight and sag". Hooked on in a jiffy, indicates tensions in seconds. Direct reading. Nine capacities, 500 to 20,000 lbs. There's a place for the Dillon in every Electrical Plant.

Send for illustrated Dynamometer Manual.

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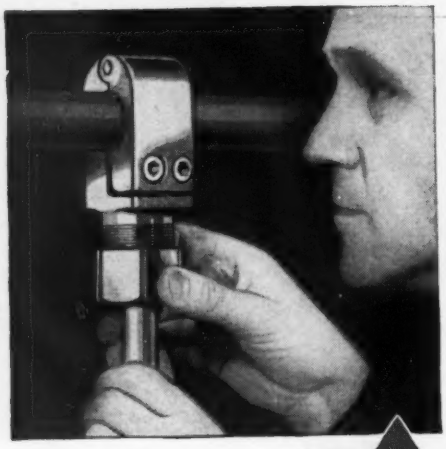

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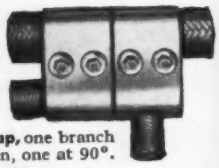
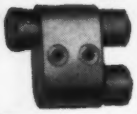
You'll find the widest variety of parallel and 90° taps, combinations, and gutter taps—in a range of sizes up to 1,000,000 cm. Insulating Bakelite covers can be furnished for all types.

Single 90° Tap from main conductor.

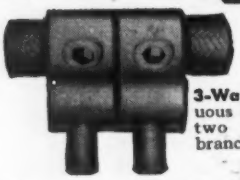


Combination Tap, one branch parallel to main, one at 90°.

2-Way Gutter Tap.



Bakelite Covers can be furnished for all types of Penn-Union cable taps.



3-Way; continuous main and two separate branches.

Also a complete line of Service Connectors, Terminals, Tees, Straight and Parallel Connectors, Grounding Connectors, etc. — every good type of conductor fitting. And every one is accurately made, thoroughly tested — *dependable.*

PENN-UNION ELECTRIC CORPORATION ERIE, PA.

PENN-UNION
Conductor Fittings

Sales Opportunities

TENNESSEE—Belding Hemingway Co., 119 West 40th St., New York, N. Y., plans new nylon throwing mill at Morristown, where large tract of land has been acquired. It will comprise a main production building, one and multi-story, and several auxiliary structures, with machinery and electrical equipment for large capacity. A power plant is planned. Entire project will cost approximately $1,500,000. Work scheduled to begin early in 1946.

OREGON—Bonneville Power Administration, Dept. of Interior, 811 N.E. Oregon St., Portland, plans new 115,000-volt transmission line from Salem, where connection will be made with present large power substation, to Tillamook, over 80 miles, with several branch lines, including a 22-mile section from Salem to Willamina, and 6-mile extension from Grande Runde to Boyer. Last noted line will replace an existing 57,000-volt line now leased from Mountain States Power Co. Another extension is planned from power substation at Tillamook air base to city area, about 5 miles. Proposed to begin work soon.

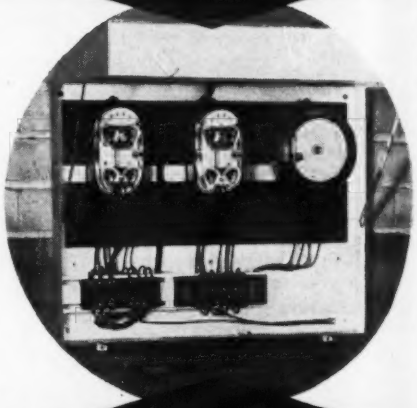
OHIO—Ohio River Power, Inc., subsidiary of Ohio Public Service Co., Cleveland, plans expansion in steam-electric generating station at Dilles Bottom, near Bellaire, including installation of new turbine-generator and auxiliary equipment. Also will make extensions in transmission lines. Cost about $2,000,000. Financing is being arranged and work will be carried out at early date.

INDIANA—Carnegie-Illinois Steel Corp., Carnegie Bldg., Pittsburgh, Pa., subsidiary of United States Steel Corp., New York, N. Y., has authorized expansion in sheet and tinplate mills at Gary, comprising large group of new buildings for main production and accessory service, with machinery and electrical equipment to increase annual output of cold rolled products from present rating of 232,600 tons to more than 1,250,000 tons per annum. Installation will include motor-generator sets, transformer stations, underground feed lines and other electrical facilities. Power plant will be enlarged and equipment installed. Program will be carried out over a period of a number of months, with ultimate investment reported in excess of $45,000,000.

CALIFORNIA—Imperial Irrigation District, El Centro, has secured permission from California District Security Commission to call special election (now planned in December), to approve bond issue for $6,200,000 for expansion and improvements in properties. Program will include new steam-electric generating plant at El Centro, additional hydro-electric power development on All-American Canal, extensions in transmission and distribution lines, power substations and other facilities, with changes in present lines at El Centro and other points. M. J. Dowd and L. F. Ready, 669 Wensley Ave., El Centro, are engineers.

OKLAHOMA—Municipal Water and Light Dept., Ponca City, plans extensions and improvements in municipal power plant, including installation of new diesel engine-operated generating unit, about 2,500-kw. capacity, and auxiliary equipment. Program is estimated to cost about $350,000. A special election is being arranged to vote bonds in that amount.

Constant Product Improvement



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If it bears the Superior name —it's a SUPERIOR product.

SUPERIOR
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CANTON, OHIO

INDIANA—E. C. Atkins & Co., Illinois and South Sts., Indianapolis, manufacturer of saws, has plans maturing for large expansion in plant, comprising group of about 10 new one, two and three-story buildings, totaling close to 500,000 sq. ft. floor space, with machinery and electrical equipment for heavy increased capacity. Cost about $1,500,000. A number of structures will be razed to make way for new units, and this work will be carried out immediately.

CALIFORNIA—Bureau of Reclamation, Denver, Colo., will receive bids until December 5 for one high-pressure gate assembly for installation in fish trap at Keswick Dam, Kennett Division, Central Valley project. Equipment will be installed by government (Specifications 1123).

ILLINOIS—Water and Light Dept., Princeton, is considering extensions and improvements in municipal power plant and waterworks station, including installation of additional equipment for increased capacity. Cost estimated close to $145,000.

VIRGINIA—Johns-Manville Corp., 22 East 40th St., New York, N. Y., has approved plans for expansion in insulating board mill at Jarrett, including several new one-story buildings, totaling about 75,000 sq. ft. floor space, with machinery and electrical equipment for large increased output. Cost estimated close to $1,000,000. Work is scheduled to proceed at once. Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass., is engineer and will supervise construction.

ILLINOIS—Public Service Co. of Northern Illinois, Chicago, plans extensions in distribution lines in parts of Grundy, Cook, McHenry and Livingston counties for rural electric service. State permission has been granted and work will begin soon.

MASSACHUSETTS — Propper-McCallum Hosiery Co., Inc., Northampton, plans expansion in mill at Florence, including main one-story building, about 135 by 215 ft., and several auxiliary structures, with machinery and electrical equipment for large increased capacity. An air-conditioning system will be installed. Entire project is estimated to cost close to $1,000,000. Work is scheduled to be placed under way soon. Stone & Webster Engineering Corp., 49 Federal St., Boston, is engineer.

VIRGINIA—Potomac Edison Co., Hagerstown, Md., plans power substation for terminal and distribution service at Double Toll Gate, near Winchester, in connection with new 66,000-volt transmission line from Millville, W. Va., about 25 miles. Line construction is scheduled for completion next spring. Entire program will represent investment of about $200,000.

MINNESOTA—Water and Light Dept., Willmar, has plans under way for extensions and improvements in municipal steam-electric power plant, with installation of additional equipment. New coal and ash-handling machinery will be installed. Estimates of cost are being made. Pfeifer & Shultz, Wesley Temple Bldg., Minneapolis, are consulting engineers.

PENNSYLVANIA—Hammermill Paper Co., East Lake Rd., Erie, will carry out expansion in mill for large increased capacity, comprising a number of new one and multi-story buildings, with machinery and electrical equipment, and other operating facilities. Extensions will be made in power plant, with installation of new turbine-generator, two high-pressure boilers, with rated capacity of 150,000 lb. of steam per hr., and auxiliary equipment. Entire project is estimated to cost about $5,500,000. Work will be placed under way at once.

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It's a trust-to-luck method—too much oil . . . or too little — IT'S ALL GUESS WORK!

INSTALL TRICO OILERS FOR . . .

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Modernize all your equipment with TRICO OILERS. Hundreds of thousands are already in service giving complete satisfaction. There's a style for every application. Write for catalog.

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Now Is the Time to Plan for Post-War Distribution of Your Products to the Electrical Distributors and Electrical Hardware Jobbers

Are you a newcomer in this market? Do you need broader distribution? We have this to offer the manufacturer of electrical products.

- 25 years experience as a National Electrical Sales Organization.
- 18 warehouses strategically located throughout the U. S.
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ALL the strength and durability inherent in steel are combined—with definite economies—in *Crapo* Galvanized Steel Strand. Heavy, ductile, tightly-bonded zinc coatings, applied by the famous *Crapo* Galvanizing Process, provide lasting protection against corrosion.

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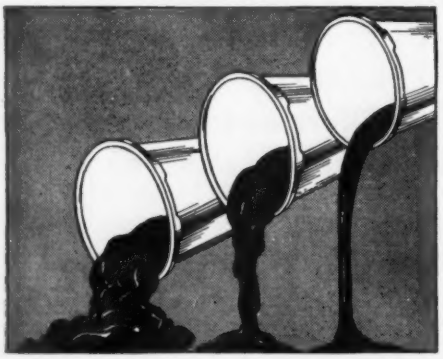
INDIANA STEEL & WIRE CO.
MUNCIE, INDIANA

Insulating and Cable-Pulling

COMPOUNDS

of Record-Breaking Performance



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Send for new literature and prices.

MINERALLAC ELECTRIC COMPANY
25 North Peoria Street—Chicago 7, Illinois

MINERALLAC

REA Announces New Allotments

Rural Electrification Administration has recently approved loan allotments totaling $21,693,000 to 122 cooperatives in 36 states. The loans, most of which will be used for line construction to extend rural electric service, include the following:

ALABAMA—Franklin Electric Co-op., Russellville, $598,000; Joe Wheeler Electric Membership Corp., Hartselle, $576,000.

ARKANSAS—Ozarks Rural Electric Co-op. Corp., Fayetteville, $420,000; Southwest Arkansas Electric Co-op. Corp., Texarkana, $300,000; North Arkansas Electric Co-op., Inc., Salem, $275,000; Craighead Electric Co-op. Corp., Jonesboro, $140,000.

CALIFORNIA—Feather Falls Electric Co-op., Inc., Feather Falls, $110,000.

COLORADO—Intermountain Rural Electric Assn., Littleton, $150,000; Mountain View Electric Assn., Limon, $193,000; Southeast Colorado Power Assn., La Junto, $114,000; Sangre de Cristo Electric Assn., Inc., Salida, $70,000.

FLORIDA—Suwanee Valley Electric Co-op., Inc., Live Oak, $261,000, including funds for substation; Lee County Electric Co-op., Inc., Fort Myers, $50,000; Tri-County Electric Co-op., Inc., Madison, $40,000.

GEORGIA—Pataula Electric Membership Corp., Cuthbert, $165,000; Amicalola Electric Membership Corp., Jasper, $123,000; Oconee Electric Membership Corp., Dudley, $80,000; Central Georgia Electric Membership Corp., Jackson, $50,000; Snapping Shoals Electric Membership Corp., Covington, $50,000; Walton Electric Membership Corp., Monroe, $50,000.

Idaho—Raft River Rural Electric Co-op., Inc., Malta, $295,000; Northern Idaho Rural Electric Rehabilitation Assn., Inc., Sandpoint, $119,000; Prairie Power Co-op., Inc., Fairfield, $64,000.

ILLINOIS—Illini Electric Co-op., Champaign, $190,000; Jo-Carroll Electric Co-op., Inc., Elizabeth, $125,000; Eastern Illinois Power Co-op., Paxton, $115,000; Egyptian Electric Cooperative Assn., Steeleville, $80,000; Illinois Rural Electric Co., Winchester, $50,000, which will be combined with a previous allotment for substation installation and improvements to the system.

INDIANA—Orange County Rural Electric Membership Corp., Orleans, $190,000; Parke County Rural Electric Membership Corp., Rockville, $40,000 for construction of headquarters building; Southern Indiana Rural Electric Co-op., Inc., Tell City, $25,000.

IOWA—Southwestern Federated Power Co-op., Inc., Greenfield, $675,000 for construction of diesel generating plant and transmission line; Federated Co-op. Power Assn., Hampton, $375,000 for construction of two generating plants; Rideta Electric Co-op., Inc., Mount Ayr, $300,000; Chariton Valley Electric Co-op., Albia, $273,000; Allamakee-Clayton Electric Co-op., Inc., Postville, $250,000, including funds for construction of 6 miles 3-phase line, substation installation and conversion of 6.75 miles of line; S. E. Iowa Co-op. Electric Assn., Mt. Pleasant, $250,000; Hawkeye Tri-County Electric Co-op., Cresco, $230,000; Nishnabotna Valley Rural Electric Co-op., Harlan, $220,000; Harrison County Rural Electric Co-op., Woodbine, $175,000 including funds for installation of a sub-

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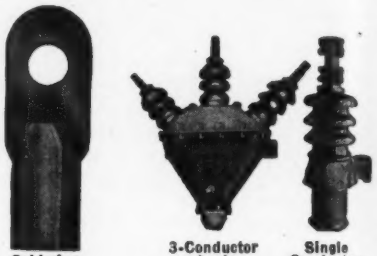

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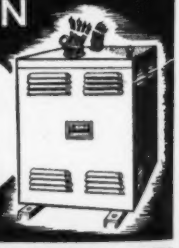

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station; Greene County Rural Electric Co-op., Jefferson, $150,000; South Crawford Rural Electric Co-op., Denison, $117,000; Humboldt County Rural Electric Co-op., Humboldt, $76,000; Osceola Electric Co-op., Inc., Sibley, $50,000.

KANSAS—Western Co-op. Electric Assn., Wakeeney, $350,000; Flint Hills Rural Electric Co-op., Inc., Council Grove, $275,000; Twin Valley Electric Co-op., Inc., Altamont, $250,000; Victory Electric Co-op. Assn., Inc., Dodge City, $200,000; Smoky Valley Electric Co-op. Assn., Inc., Lindsborg, $90,000.

KENTUCKY—Salt River Rural Electric Co-op. Corp., Bardstown, $195,000; Meade County Rural Electric Co-op. Corp., Brandenburg, $160,000.

LOUISIANA—Beauregard Electric Co-op., Inc., DeRidder, $422,000; Valley Electric Membership Corp., Natchitoches, $260,000; Concordia Electric Co-op., Inc., Ferriday, $222,000; Dixie Electric Membership Corp., Baton Rouge, $208,000, including funds for headquarters building; Northeast Louisiana Power Co-op., Inc., Winnsboro, $100,000.

MAINE—Kingman Electric Co., Kingman, $112,000.

MINNESOTA—Rural Co-op. Power Assn., Maple Lake, $500,000 for installation of two generating units and construction of plant building; Minnesota Valley Co-op. Light & Power Assn., Montevideo, $400,000; Agra Lite Co-op., Benson, $330,000; Stearns Co-op. Electric Assn., Melrose, $215,000; Red River Valley Co-op. Power Assn., Halstad, $198,000; North Itasca Electric Co-op., Inc., Bigfork, $180,000; Freeborn-Mower Co-op. Light & Power Assn., Albert Lea, $160,000; Blue Earth-Nicollet Co-op. Electric Assn., Mankato, $100,000.

MISSISSIPPI—Magnolia Electric Power Assn., McComb, $200,000.

MISSOURI—Southwest Electric Cooperative, Bolivar, $265,000; Barton County Electric Co-op., Lamar, $235,000; Ozark Electric Cooperative, Mt. Vernon, $132,000; Missouri Rural Electric Co-op. Assn., Palmyra, $130,000; New-Mac Electric Co-op., Inc., Neosho, $130,000.

MONTANA—Ravalli County Electric Co-op., Inc., Corvallis, $70,000.

NEBRASKA—Seward County Rural Public Power District, Seward, $170,000; Polk County Rural Public Power District, Stromsburg, $95,000; Chimney Rock Public Power District, Bayard, $80,000.

NEW MEXICO—Central Valley Electric Co-op., Inc., Artesia, $50,000.

NEW YORK—Delaware County Electric Co-op., Inc., Delhi, $50,000; Oneida-Madison Electric Co-op., Inc., Bouckville, $40,000.

NORTH CAROLINA—Lumbee River Electric Membership Corp., Raeford, $156,000; Davidson Electric Membership Corp., Lexington, $50,000.

NORTH DAKOTA—McLean Electric Co-op., Inc., Garrison, $100,000; Mountrail Electric Co-op., Inc., Stanley, $100,000.

OHIO—Belmont Electric Co-op., Inc., St. Clairsville, $165,000; Marion Rural Electric Cooperative, Inc., Marion, $75,000; Tuscarawas-Coshocton Electric Co-op., Inc., Coshocton, $55,000; Pioneer Rural Electric Co-op., Inc., Piqua, $5,000 for refrigerated locker facilities.

OKLAHOMA—Verdigris Valley Electric Co-op., Inc., Collinsville, $247,000; Central Rural Electric Co-op., Stillwater, $235,000; People's Electric Co-op., Ada, $225,000; Kiwash Electric Co-op., Inc., Cordell, $205,000; Red River Valley Rural Electric Assn., Marietta, $195,000; Northeast Oklahoma Electric Co-op., Inc., Vinita, $185,000; Northwestern Electric Co-op., Inc., Woodward, $166,000.

OREGON—Northeast Clackamas County Electric Co-op., Inc., Sandy, $38,000; Central Electric Co-op., Inc., Redmond, $15,000.

PENNSYLVANIA—Bedford Rural Electric Co-op., Bedford, $30,000.

SOUTH CAROLINA—Santee Electric Co-op., Kingstree, $155,000; Palmetto Electric Co-op., Inc., Ridgeland, $82,000; Marlboro Electric Co-op., Inc., Bennettsville, $50,000.

SOUTH DAKOTA—Turner-Hutchinson Electric Assn., Inc., Freeman, $400,000; James River Valley Electric Assn., Aberdeen, $85,000; Whetstone Valley Electric Assn., Inc., Milbank, $50,000.

TEXAS—Sam Houston Electric Co-op., Inc., Livingston, $280,000; Hamilton County Electric Co-op., Assn., Hamilton, $240,000; Rusk County Electric Co-op., Inc., Henderson, $155,000; Guadalupe Valley Refrigeration Co-op., Inc., Cost, $34,000 for refrigerated locker facilities; Kimble Electric Co-op., Inc., Junction, $25,000.

UTAH—Dixie Rural Electric Co-op., St. George, $38,000.

VERMONT—Vermont Electric Co-op., Inc., Johnson, $95,000.

VIRGINIA—Northern Piedmont Electric Co-op., Culpeper, $417,000; Northern Neck Electric Co-op., Warsaw, $50,000.

WASHINGTON—Public Utility District No. 1 of Clallam County, Forks, $370,000, which includes funds for construction of 52 miles of transmission line.

WEST VIRGINIA—Hardy County Light & Power Assn., Inc., Moorefield, $25,000.

WISCONSIN—Dairyland Power Co-op., La-Crosse, $1,160,000 for generating facilities; Oakdale Co-op. Electric Assn., Oakdale, $175,000; Bayfield Electric Co-op., Inc., Iron River, $170,000; Waushara County Electric Co-op., Inc., Wautoma, $125,000; Adams-Marquette Electric Cooperative, Friendship, $117,000; Crawford Electric Co-op., Gays Mills, $117,000; Clark Electric Co-op., Greenwood, $86,000; Columbus Rural Electric Co-op., Columbus, $72,000.

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Opens Western Offices

Announcement has been made by the Triangle Conduit & Cable Co., Inc., New Brunswick, N. J., of the establishment of their own branch offices on the Pacific Coast. Rex E. Larsen is district manager at the Los Angeles office, 923 East Third St.; M. L. Fowler at the San Francisco office, 1045 Bryant St., San Francisco 5; Roger W. Baylee at the Seattle office 2424 Harvard Avenue North, Seattle 2.

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Carrier Backlog $12,000,000

In a report sent to stockholders, Carrier Corp. showed net profit carried to earned surplus for the 12 months ended August 31, 1945, amounting to $632,550. This includes carry-back tax refund of $258,800. As of August 31, Carrier Corp. had a backlog of $12,130,313, the bulk of which is made up of orders for peacetime products and services. Cloud Wampler, president, said that "new orders are being booked in highly satisfactory volume."

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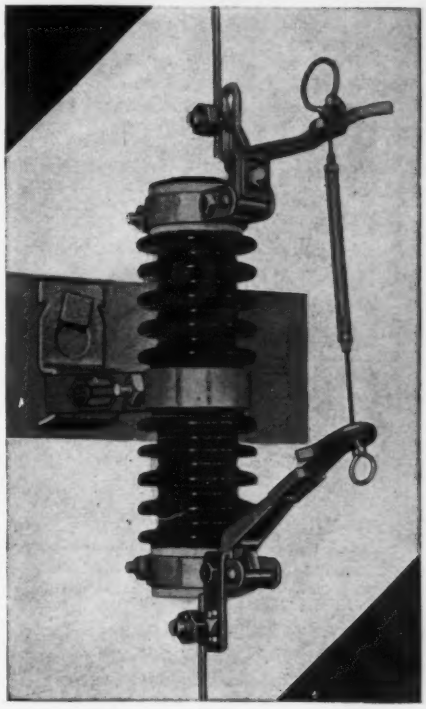

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